The Farm Sector of Tomorrow

by

Luther Tweeten*

As a guide to the future, this report examines trends in Ohio's agricultural sector here broadly defined to include farm, food, and fiber industries. These trends aren't set in concrete -- they can be changed. The ideas for farm income enhancement presented at this conference can make a difference.

The report emphasizes farming because that industry is the focus of this conference. But agriculture is much more than farming as noted in the following section on the contribution of agriculture to the economy of Ohio. The paper then notes changes in the farming industry over time and the major forces behind those changes before drawing conclusions for the future of agriculture. The final section shows the importance of research and extension to income enhancement by keeping Ohio's agriculture productive and competitive.

Contribution of Agriculture to the Economy of Ohio

Prices for many products are set in national and international markets over which Ohio has little control. However, the economic destiny of Ohio depends heavily on the level and productivity of human, material, and natural resources over which the state has

* *Anderson Professor of Agricultural Marketing, Policy, and Trade, Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus.* *Paper presented to Exploratory Conference on Farm Income Enhancement, Dublin, Ohio, April 11, 1989. Comments of Lynn Forster and Dennis Henderson are much appreciated.*

much influence. Secondary and tertiary economic activity rests on basic industries such as farming and manufacturing which bring in dollars from outside the state. The future of the Ohio economy depends heavily on agriculture.

Ohio's agricultural resources are vast. In 1986 for example, the state's 80,000 to 84,000 farms (depending on whether USDA or U.S. Census sources of farm numbers are used) had assets totaling over $22 billion of which $15 billion were real estate. The farms of the state occupy 15 million acres, or 60 percent of the state's land area. Gross farm income in 1986 and 1987 totaled over $4 billion and farm production expenses over $3 billion, leaving a net farm income of approximately $1 billion in each year.

As a result of public and private efforts, farmers and the agricultural industry have made massive productivity gains. Ever fewer workers in agriculture have been able to supply domestic food and fiber needs and exports to supply foreign exchange for purchasing products from abroad. Millions of acres in the U.S. and thousands in Ohio have been saved from erosion on fragile soils which would have been cropped in the absence of productivity gains in agriculture.

The U.S. Department of Agriculture selected Ohio for an annual telephone survey to complement the five-year Census of Agriculture in part because the state is representative of the nation. Where Ohio's agricultural economy is unlike the nation's, differences often can be explained by:

1. *High urban-industrial intensity.* Competition between agriculture and other industries for workers and land results in high labor costs, many small and part-time farms, and competition for farmland.

2. *A key position between the agriculturally rich cornbelt and the population centers of the state, the region, and of the east coast.* This helps to explain the large food processing industry.

3. *Access to foreign markets.* The state enjoys convenient access to foreign markets through (a) the Great Lakes-St. Lawrence Seaway, (b) the Ohio-Mississippi River, and (c) unit trains to the ports of Baltimore and Philadelphia. That is one reason why Ohio exports large quantities of soybeans, corn, and wheat.

The following tables and figures reflect changes in Ohio's agriculture originating not only from increasing productivity but also from shifts in demand, urbanization, and industrialization.

Employment in Agriculture

Agriculture is comprised of "upstream" input supply industries such as fertilizer, feed, seed, and machinery industries and "downstream" industries from the farm sector including agricultural processing and marketing. Table 1 summarizes full-time equivalent employment in each industry for 1981 and 1986.

Several notable observations are apparent from Table 1:

1. Agricultural sector employment totaled 562,067 workers in 1986, down 2.7 percent from 1981. The direct share of agriculture in Ohio's total employment dropped from 16 percent in 1981 to 15 percent in 1986.

2. The wholesale and retail food distribution industry was by far the largest in agriculture, accounting for nearly 400,000 workers in 1986. It was the only

major industry in the farm, food, and fiber sector which expanded employment between 1981 and 1986. Many agricultural industries were troubled by financial stress during this period.

3. Farm input supply employment totaled nearly 19,000 workers in 1986, down 17 percent from 1981. The financial stress experienced by agriculture in the 1980s took an especially heavy toll of the farm input supply industry.

4. Farming accounted for 38,916 full-time equivalent workers in 1986, down 9 percent from 1981.

Ohio ranked in the top ten states in receipts from several farm commodity categories in 1987:

Commodity	Rank
Tomatoes	3
Corn	6
Soybeans	6
Dairy Products	7
Lettuce	7
Hogs	8
Grapes	8
Apples	9
Eggs	9
Tobacco	10
All crops	10

Source: U.S. Department of Agriculture, November, 1988, p.6.

The state ranks high some years in other categories. For example, Ohio ranked tenth in the nation in greenhouse and nursery product receipts in 1986.

Table 1. Agricultural (Farm and Food Sector) Employment by Industry, 1981 and 1986.

Industry	Full-time Equivalent Employment 1981	1986	Percent Change
Farm Input Supply	22,869	18,874	-17.5
Farm	42,675	38,916	- 8.8
Food Processing	63,935	53,673	-16.1
Fiber Processing	5,288	5,638	6.6
Lumber and Wood Products	22,800	15,506	-32.0
Paper and Paper Products	38,491	31,404	-18.4
Food Distribution (Wholesale and Retail)	381,359	398,056	4.4
Total Agriculture	577,417	562,067	- 2.7
Share of Total Ohio Employment (%)	16	15	

Source: 1981 data from Governor's Commission on Agriculture. 1986 data from U.S. Bureau of the Census (May 1988 and January 1989).

5. The food processing industry in Ohio is large, accounting for 53,673 workers and approximately 1,000 firms. Many of the firms are of small size. Food processing also lost considerable employment between 1981 and 1986 although not as high a percentage loss as experienced by lumber and wood products and by paper and paper products -- industries sometimes peripherally related to agriculture.

The following data highlight Ohio's top processed foods. It is notable that the state ranks number one in production of frozen dinners and swiss cheese. It ranks high in many other processed commodities as well.

Food	National Rank[a]	Value of Shipments
		($ million)
Milk	5	1,585
Fats and Oils	4	1,129
Beer	5	810
Bread and Cakes	5	710
Condensed Evaporated Milk	2	464
Frozen Dinners	1	343
Soft Drinks	4	307
Eggs	5	184
Popcorn	3	180
Tomato Products	2	121
Potato Chips	3	116
Swiss Cheese	1	118
Ice Cream and Frozen Desserts	5	96
Pickles, Sauces, and Salad Dressing	5	75
Cottage Cheese	4	38
Wines	3	37

Source: Food Processing by John Conner.
[a] Where Ohio production ranks nationally.

Employment Multipliers for Ohio's Agricultural Industries

Basic industries generate jobs in other industries. That linkage with other industries is measured by the employment multiplier, defined as the number of jobs created in the entire economy of the state per job added in a specific industry. Two types of multipliers are widely used. Table 2 shows each type of multiplier for Ohio's agricultural industries. A *type I multiplier* includes that initial job created directly in an industry plus indirect employment generated in related industries. An example is a job added in farming causing additional employment in input supply and marketing firms as farmers purchase more inputs

and sell more products.

Table 2. Multipliers for Ohio's Agricultural Industries.

Industry	Multipliers I[a]	Multipliers II[b]
Farm Input	1.98	5.21
Farm	1.85	4.26
Food Processing	3.12	7.37
Fiber Processing	1.39	2.76
Lumber and Wood	1.67	3.64
Paper and Paper Products	2.21	5.75
Food Distribution	1.23	2.43
Total Agriculture	1.32	2.28

Source: Governor's Commission on Agriculture.

[a] Type I Multiplier: Includes in the case of farming industry, for example, the employment generated by farmers' purchases from input supply industries and by farmers' sales to marketing and processing firms.

[b] Type II Multiplier: Includes Type I multiplier plus employment induced by purchases of, for example, medical, legal, recreational, and education services, and of items such as household supplies from income generated directly and indirectly.

A *type II multiplier* includes direct, indirect, and induced effects. Additional employment in farming or food processing creates household income which induces employment when it is spent for medical, legal, educational, and other services and for household, personal, and other goods. Because type II multipliers include type I multipliers, the type II multipliers are larger. It is cautioned that the multipliers only indicate the

impact on employment of a job created in the given industry. The multipliers do not necessarily imply that it is economically feasible or desirable to expand employment. In a full-employment economy if a job created in food processing costs more than it adds to the value of output, the nation loses gross national product even if the multiplier is large.

Type I industry multipliers range from a low of 1.23 for the food distribution (wholesaling and retailing) industry to a high of 3.12 for food processing. The latter means that an additional worker added to the food processing industry adds on average 3.12 workers to Ohio's economy, including the initial worker added in food processing. Type II multipliers range from 5.75 in the paper and paper products industry to 2.28 for agriculture as a whole. The multipliers are lower for total agriculture than for any one component because each component contains overlap which if simply summed would double-count some employment.

Applying the multipliers of Table 2 to the direct employment numbers in Table 1 more completely measures the contribution of Ohio's agriculture to the state's economy as noted in Table 3.

1. Farming directly contributed 38,916 full-time equivalent workers to employment in 1986 but through indirect effects on other industries contributed 72,000 workers. Combining direct, indirect, and induced effects, farming contributed 166,000 workers. Agriculture's share of the state's economy went from 15 percent considering only direct employment to 20 percent considering direct and indirect employment, and to 34 percent considering direct, indirect, and induced employment.

Table 3. Agricultural Employment by Industry Considering Indirect and Induced Employment.

Industry	Direct and Indirect	Direct, Indirect, and Induced
	(1,000 full-time equivalents)	
Farm Input Supply	38	99
Farm	72	166
Food Processing	168	398
Fiber Processing	8	17
Lumber and Wood Products	27	58
Paper and Paper Products	69	178
Food Distribution (Wholesale and Retail)	490	967
Total Agricultural Sectors	742	1,281
Share of Total Ohio Employment	20	34

Source: See Tables 1 and 2.

2. Considering only the far right column for direct, indirect, and induced employment in Table 3, it appears that eight persons (1,281/166 = 7.7) are employed in "total agriculture" for each worker in the farm sector. This is a misleading measure of the employment multipliers, however, because many of the workers in food and fiber industries would remain in the state even in

the highly unlikely case that food and fiber raw materials would be imported. In short, agriculture's economic health heavily influences the direction of the state's economy.

3. Rules of thumb are expedient and sometimes helpful to measure the impact of agriculture on the state's economy. As a general rule, for *each additional worker* (full-time operator or hired, gainfully employed) *in farming* the following employment impacts result:

1	the original worker in farming generates
1	an "upstream" worker added to supply inputs to the farmer plus
2	"downstream" workers added in transportation, storage, processing, wholesaling, and retailing.
4	total state multiplier.

Alternatively, the employment multiplier approximately can be defined as follows for a *farm worker added in a geographic trade area* containing farms and local trade area commuters:

1	the original worker added to farming generates
1	additional worker added in input supply and marketing firms within the trade area plus
2	workers added outside the trade area within the state plus
1	worker added outside the state and in the nation.
5	total national farming multiplier.

Past and Prospective Farming Trends

Given the focus of this conference on farm income enhancement, it is well to examine past trends in farm income, output, balance sheets, resources, and other characteristics to gain insights into future trends and how these have been and could be

influenced in the future by various forces.

Gross Farm Income, Net Farm Income, and Farm Production Expenses

Net farm income in Figure 1 is the difference between gross farm income and farm production expenses in Ohio.

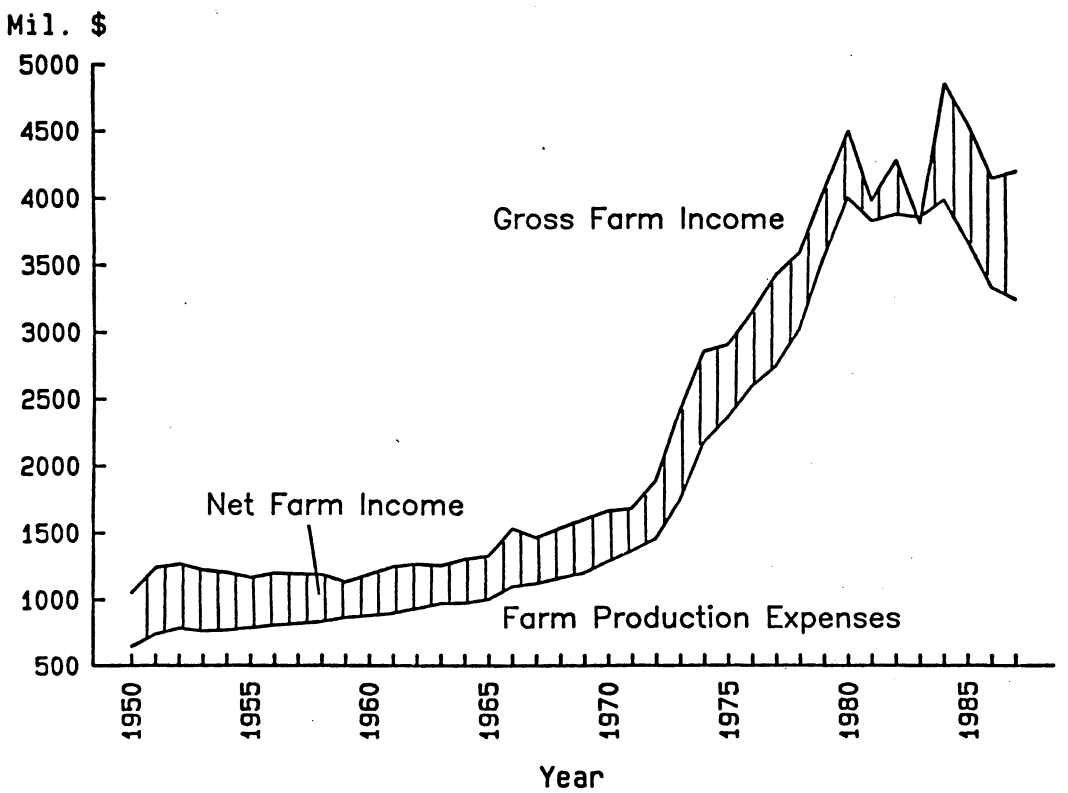

Figure 1. Actual Ohio Farm Income, 1950-1987.

Two observations are noted:

1. Both farm production expenses and gross farm income increased sharply to 1980.

2. Net farm income varied widely from year to year in the early 1980s. The narrow band of net farm income indicates frequently narrow profit margins in farming. Ohio is not unique among states in displaying unstable net farm income over time.

More realistic comparisons of income trends in Ohio's agriculture are possible only by expressing data in real terms. The implicit price deflator of the Gross National Product is used to remove the inflation trend and express income and expenses in constant (1987) dollars in Figure 2.

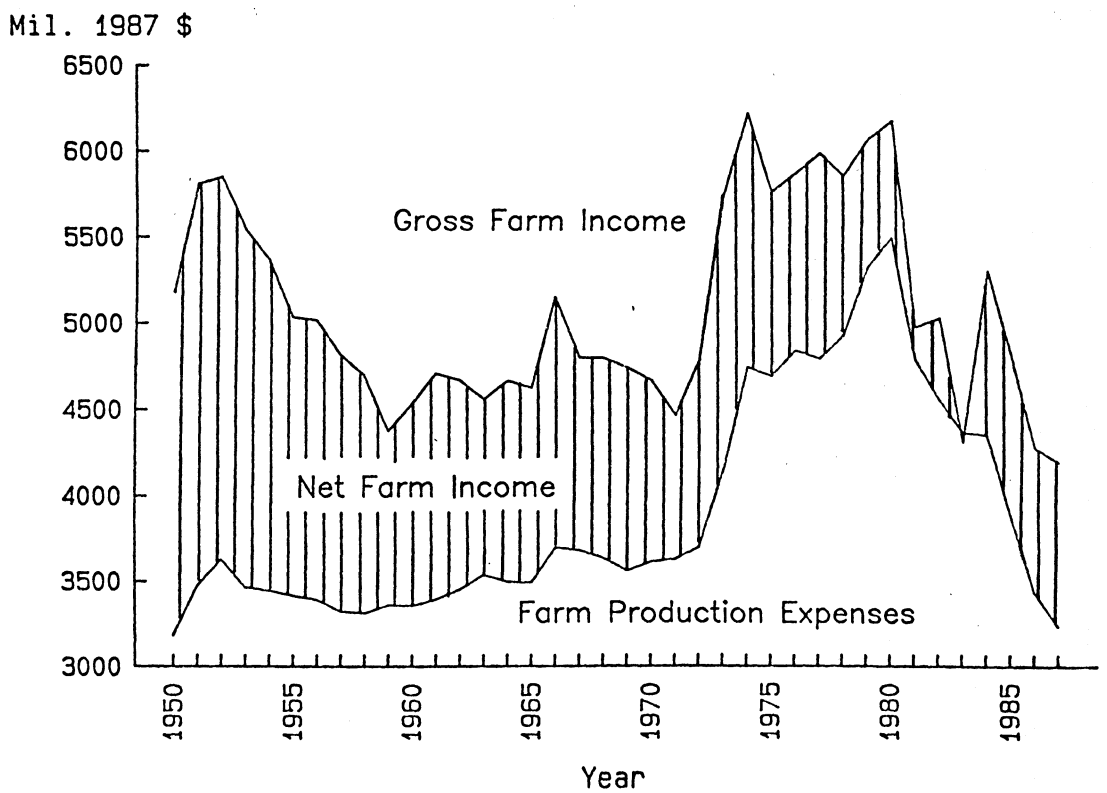

Figure 2. Real Ohio Farm Income, 1950-1987.

Highlights include:

1. Farm production expenses rose sharply in real terms in the 1970s, then fell about as sharply in the 1980s.
2. Net farm income has generally trended downward over time but, because gross farm income dropped much faster than expenses in the early 1980s, real net farm income was near zero or negative in the early 1980s.
3. Two post-World War II types of periods are apparent in Figure 2. Real gross income of Ohio agriculture was high in the 1950s because of strong demand following World War II, and in the 1970s because of strong domestic and export demand in the face of overall expansion in the world economy. The second period of lower real gross income was associated with lower demand and attendant interventions of commodity programs in the 1960s and 1980s. We cannot predict precisely whether the 1990s will be characterized by the strong demand and high output of the 1950s and 1970s or by the lower demand and output of the 1960s and 1980s. Projections from other sources (Tweeten, 1988) point to a scenario somewhere between these extremes for the 1990s.
4. Government payments are not shown in Figures 1 and 2 but have often been an important component of net farm income. Payments and their proportion of net farm income for recent years are as follows:

Year	Government Payments	Government Payments per Farm	Percent of Net Farm Income
	(Mil. $)	($)	
1984	232.2	2,580	27
1985	149.7	1,682	17
1986	269.0	3,057	33
1987	431.9	5,142	45

Source: U.S. Department of Agriculture, November 1988.

5. The economic situation of the farmer is incomplete without including off-farm income:

Year	Net Farm Income	Off-farm Income	Total Income
		(dollars per farm)	
1984	9,672	19,789	29,460
1985	9,761	21,899	31,660
1986	9,248	23,207	32,455
1987	11,383	25,471	36,854

Source: U.S. Department of Agriculture, November 1988.

Off-farm income of Ohio's farmers was more than double their net farm income in each of the years from 1984 to 1987. This highlights the importance of part-time farming in Ohio, a subject addressed in more detail later.

Ohio Farming - A Growth Industry

Ohio farming is a growth industry as measured by output of crops and livestock in Figure 3.

1. Overall crop production (as measured by crop receipts deflated by prices received by farmers for crops) was 3.21 times as large in 1987 as in 1950 -- an average compound rate of gain of 3.2 percent per year.

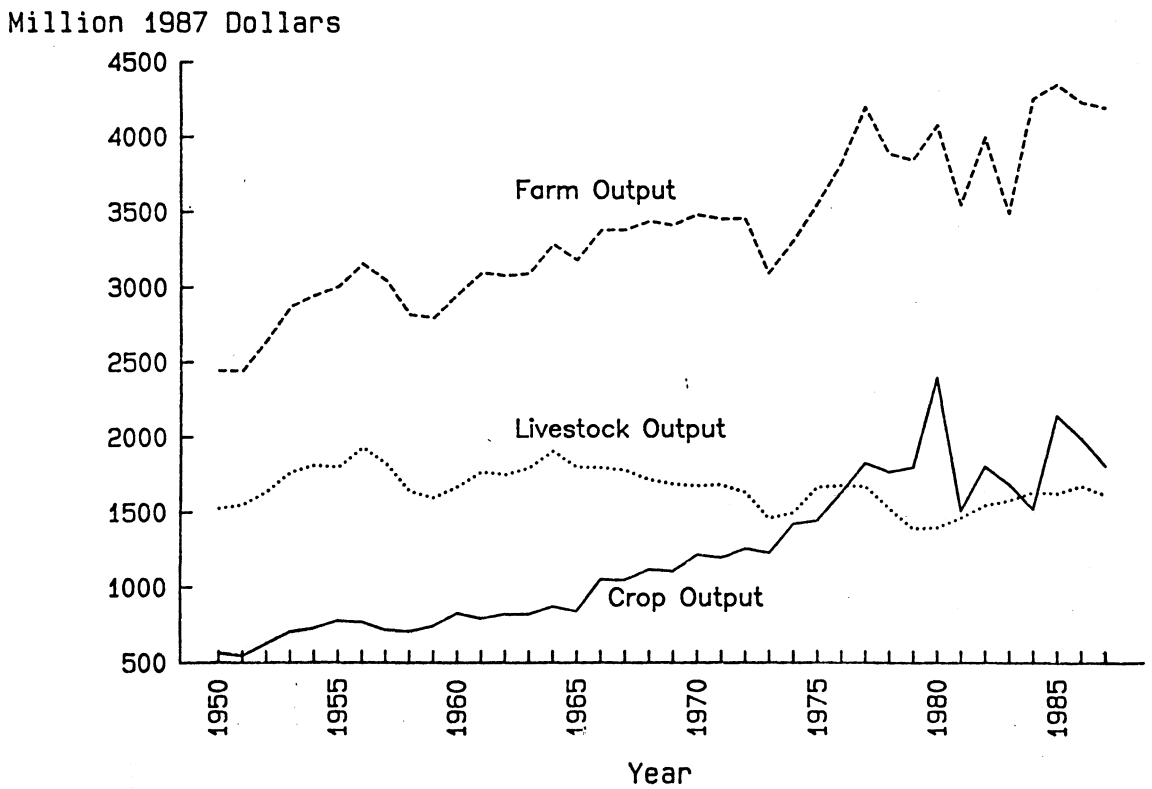

Figure 3. Ohio Real Farm Output.

2. Livestock output did not perform as well as crop output and was only 6 percent greater in 1987 than in 1950. Livestock output was nearly triple crop output in 1950 but by the 1980s crop and livestock output were nearly equal.

Of course, crop output varies widely because of weather and commodity programs of the government as especially apparent in the 1980s.

3. The graphs for crop output and livestock output in Figure 3 only include marketed output. A more complete measure of output also includes products of the farm consumed on the farm and output that would have been produced in the absence of government production controls. The latter is crudely approximated by including deflated government payments in farm output. By this measure *overall* farm output of the state shown in Figure 3 increased 72 percent from 1950 to 1987, an average increase of 1.5 percent per year.

Competitiveness of the State's Farming Industry

How Ohio's agricultural economy will fare in the future depends partly on unpredictable national and international markets and policies mostly beyond the state's control but also on its comparative advantage among states. The latter can be influenced by state policies such as agricultural research, extension, and education -- some of which are discussed later.

How competitive is Ohio's agriculture in the national economy? To examine that issue Figure 4 shows Ohio agricultural receipts as a percent of U.S. agricultural receipts from 1950 to 1987.

Two observations are apparent:

1. Farming receipts in Ohio have fallen relative to those in the nation.
2. The downward trend appears to be slowing and contains much variation. Hence it is difficult to make inferences regarding the future. However, the

past trend begs explanation which will be addressed in subsequent sections of this report.

Figure 4. Ohio Agricultural Receipts, 1950-1987, Percent of U.S.

Figure 5 illustrates that:

1. Measured by the proportion of Ohio crop and livestock receipts in the U.S. total, Ohio has remained highly competitive in crop production but has fallen sharply in livestock production relative to the nation.
2. Ohio accounts for over 2 percent of the livestock receipts and for over 3 percent of crop receipts in the nation.

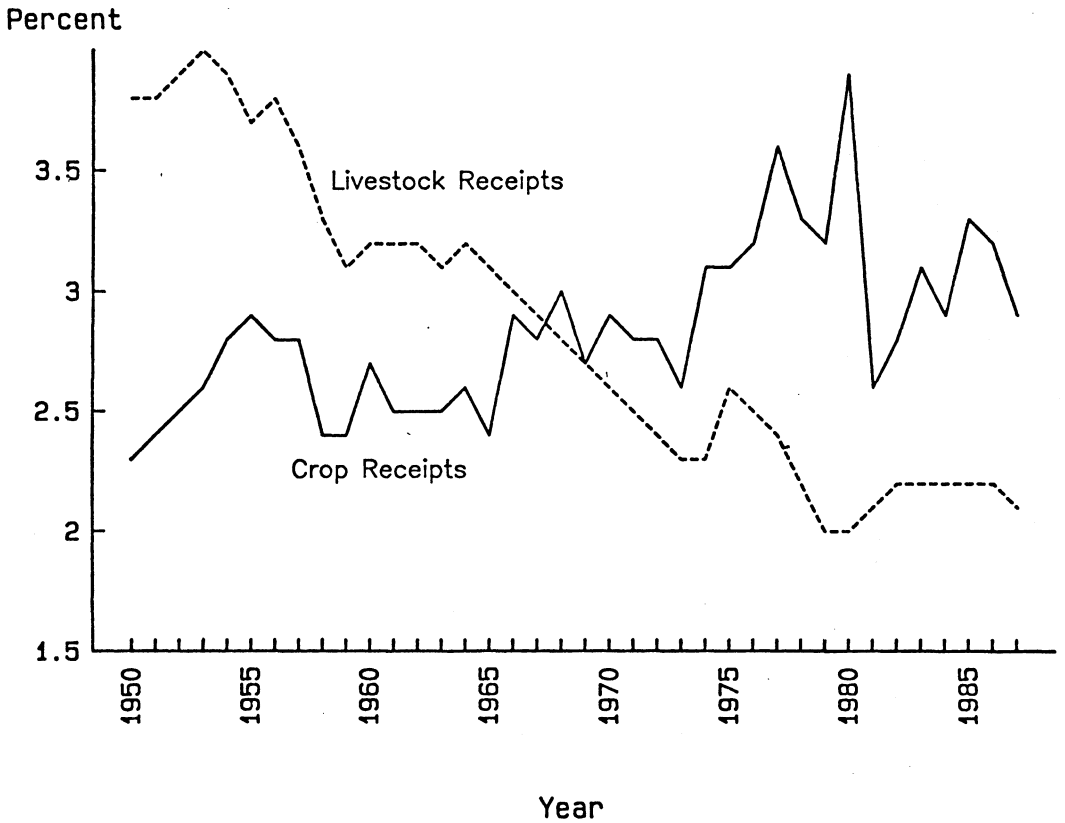

Figure 5. Ohio Crop and Livestock Receipts, Percent of U.S.

Crop Receipts in Ohio

Figure 6 highlights notable trends in crop receipts by commodity as a proportion of all crop and livestock receipts in Ohio:

1. Crop receipts increased from approximately one-third of all farm receipts in the state in 1950 to two-thirds of farm receipts in the early 1980s, then fell in 1987. Recent years have been especially influenced by volatile weather and commodity program policies.
2. Corn and soybeans dominate crop production with wheat falling into third place. These crops, which accounted for one-third of crop receipts in 1950,

typically accounted for two-thirds of crop receipts in the 1980s.

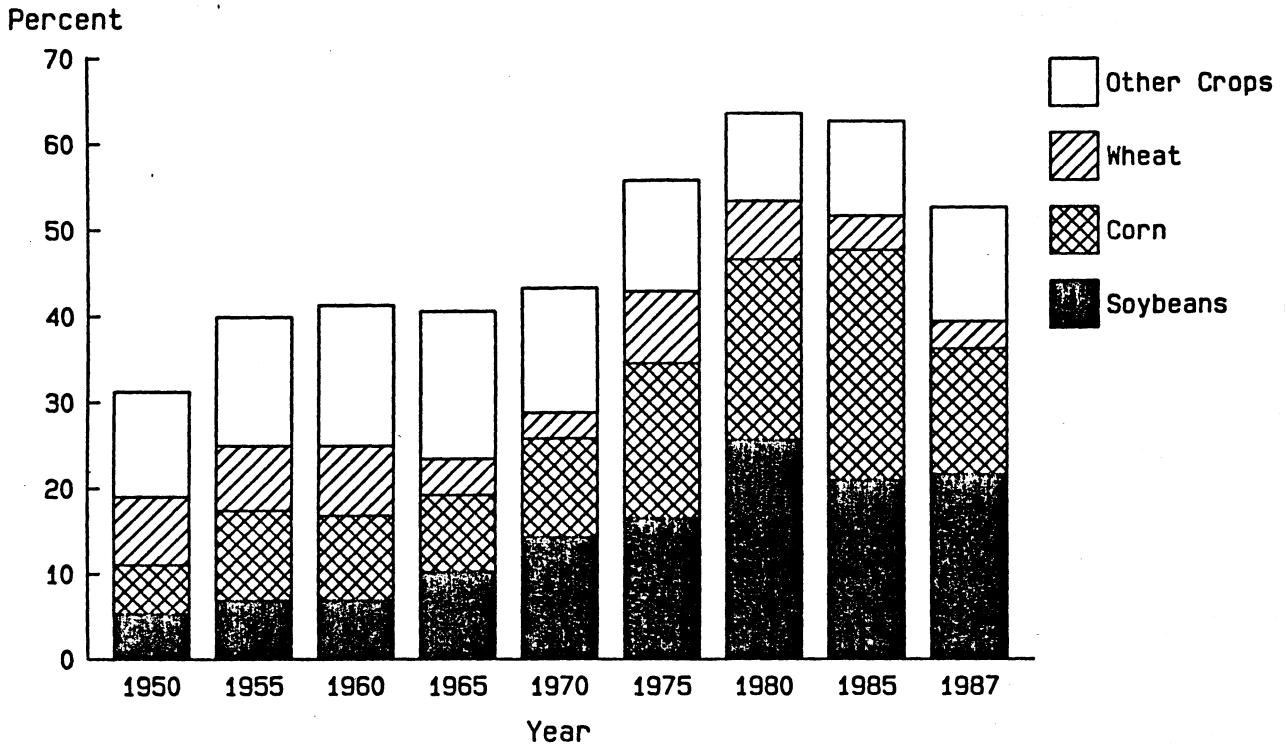

Figure 6. Share of Ohio Crop Receipts for Selected Years, 1950-1987.

Patterns of crop production are vividly apparent in Figure 7.

1. The volume of corn production has been much greater than of soybean or wheat production.
2. Corn real receipts and soybean real receipts (not shown) have displayed remarkably similar trends, and have been at nearly the same level since 1960.

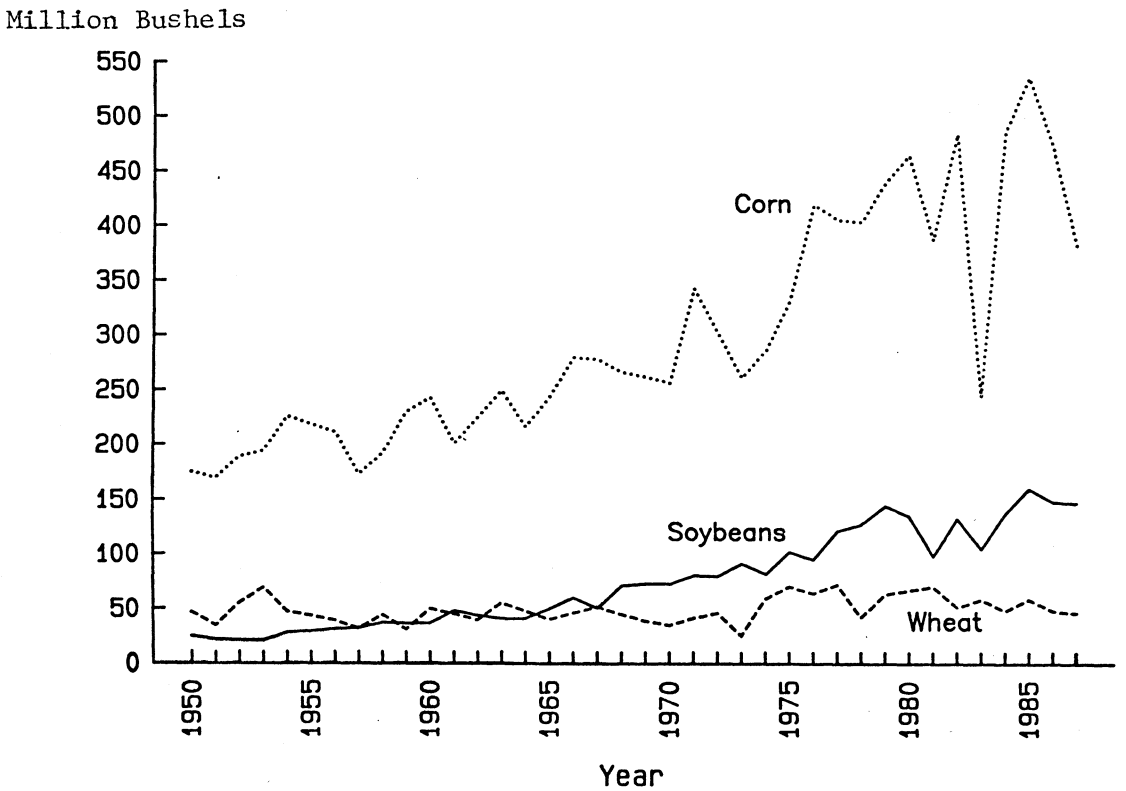

Figure 7. Ohio Crop Production.

Relative competitive advantage is measured in Figure 8 for individual commodities by Ohio crop receipts as a percent of U.S. crop receipts from 1950 through 1987.

1. Ohio's share of soybean production fell from 1950 to the early 1960s and since has shown a variable but slowly rising trend.
2. The state's corn production shows no strong trend over time relative to national production.
3. Wheat shows a generally declining trend in Ohio relative to the nation.

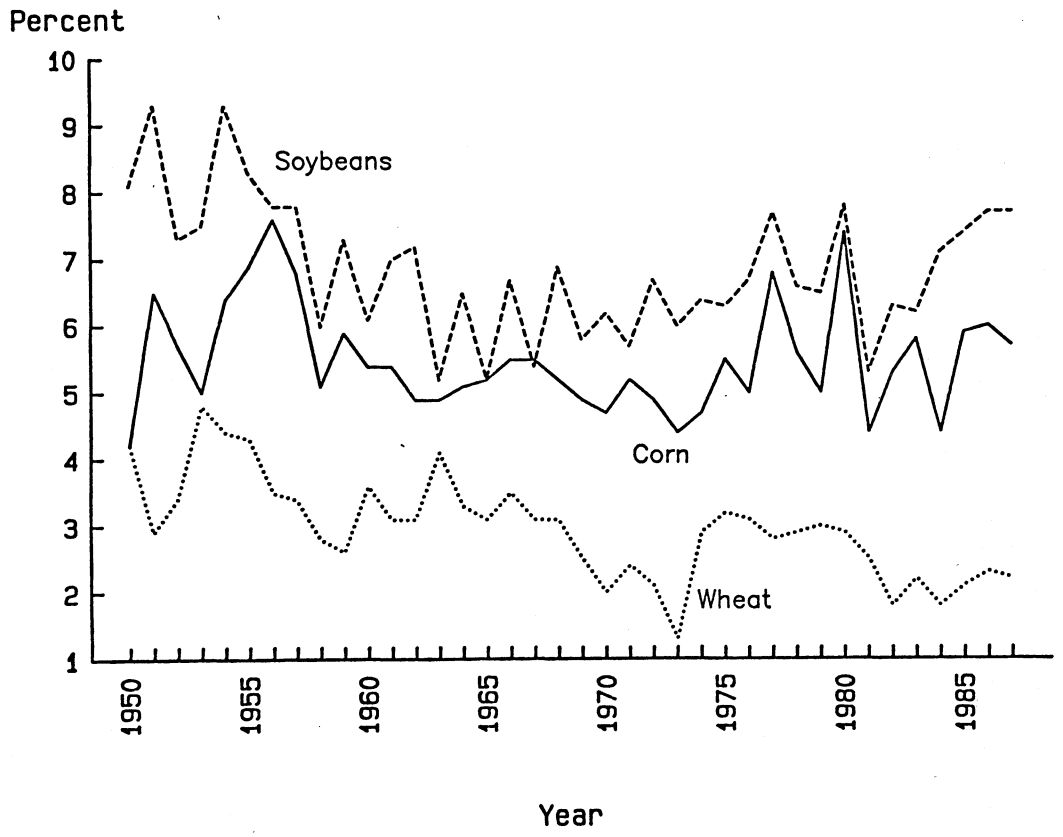

Figure 8. Ohio Crop Receipts, Percent of U.S.

Ohio Livestock Production

The shares of all farm receipts accounted for by all livestock and major categories of livestock are shown in Figure 9. The figure is the mirror image of Figure 6; as crop production rose livestock production fell.

Conclusions from Figure 9 are that:

1. Although the overall share of livestock in all farm receipts has fallen, the shares of livestock receipts accounted for individually by poultry, dairy, and meat animals have not changed much comparing 1987 with 1950.

2. "Other livestock" such as sheep and goats account for a very small percentage of total receipts in the state.

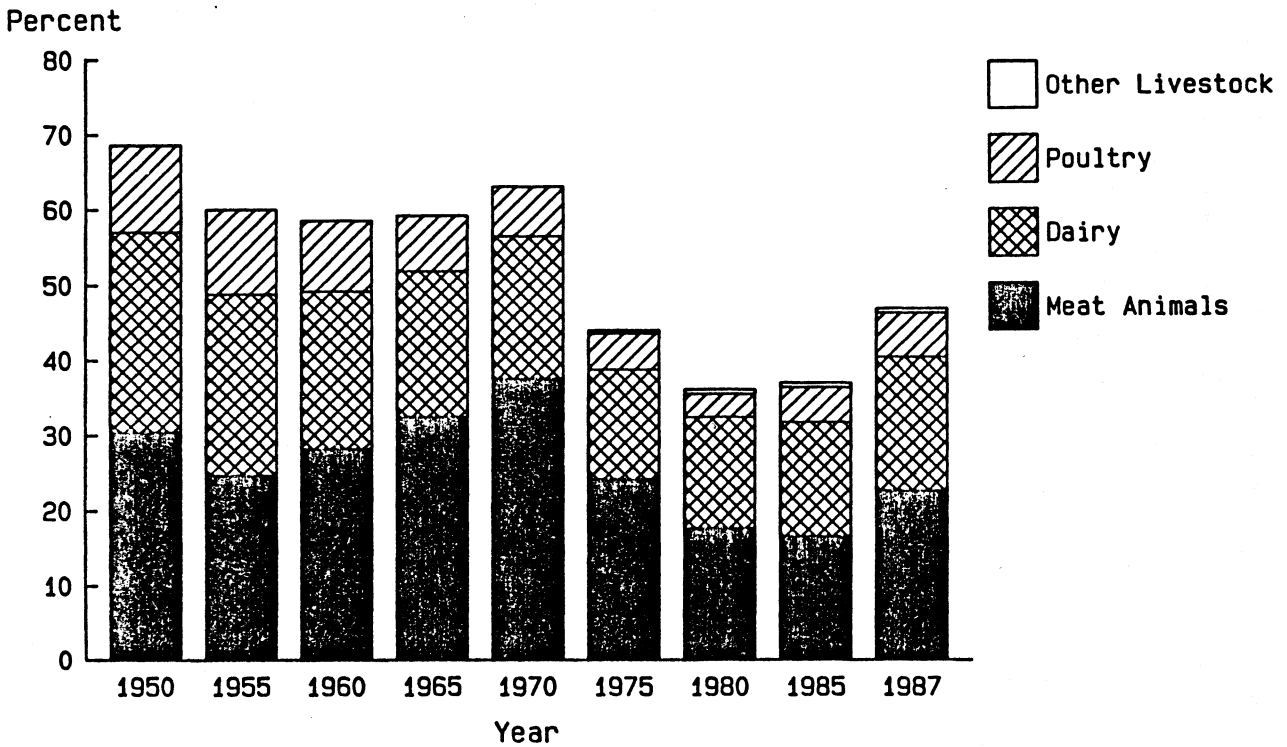

Figure 9. Share of Ohio Livestock Receipts for Selected Years, 1950-1987.

Figure 10 affirms results in Figure 9 showing downtrends in most components of livestock real receipts since 1950.

1. An exception is cattle real receipts which increased substantially to the mid-1970s, then dropped sharply. Commodity cycles influence especially cattle and hog real receipts.
2. The substantial drop in livestock output occurred in the 1950s; since then the change in livestock production has been gradual.

3. Cattle and hog receipts have been nearly equal since the 1960s.

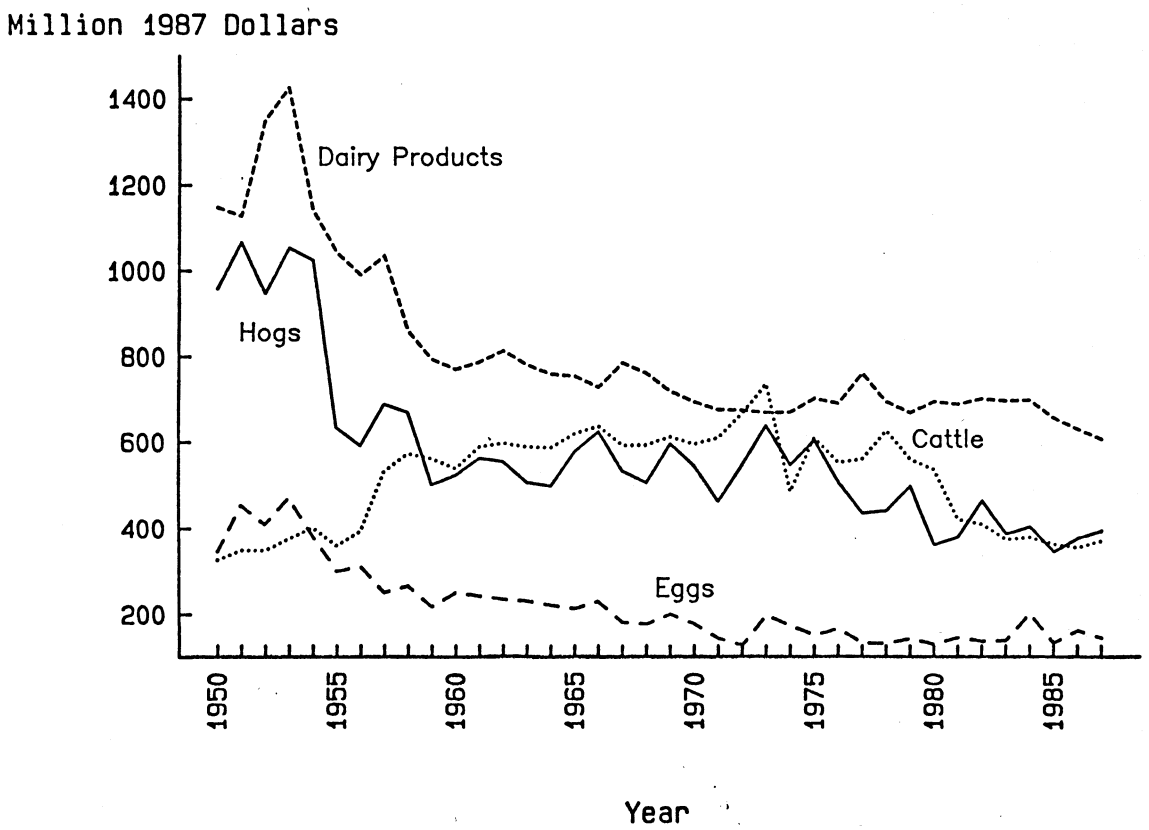

Figure 10. Ohio Real Livestock Receipts.

The competitive advantage of Ohio in livestock production can be gauged from the livestock shares shown in Figure 11. Even if livestock production is falling in Ohio, the state may still display a competitive advantage if production is falling faster elsewhere. That tendency is apparent in some cases in Figure 11.

1. Two periods are apparent in Figure 11. The first is from the mid-1950s to 1980 when shares of national dairy, cattle, hog, and egg production fell in Ohio.

2. The second period is since 1980 when shares of dairy, egg, and hog production increased in the state. Cattle in the state have accounted for a small and largely unchanging share of national production since 1980.

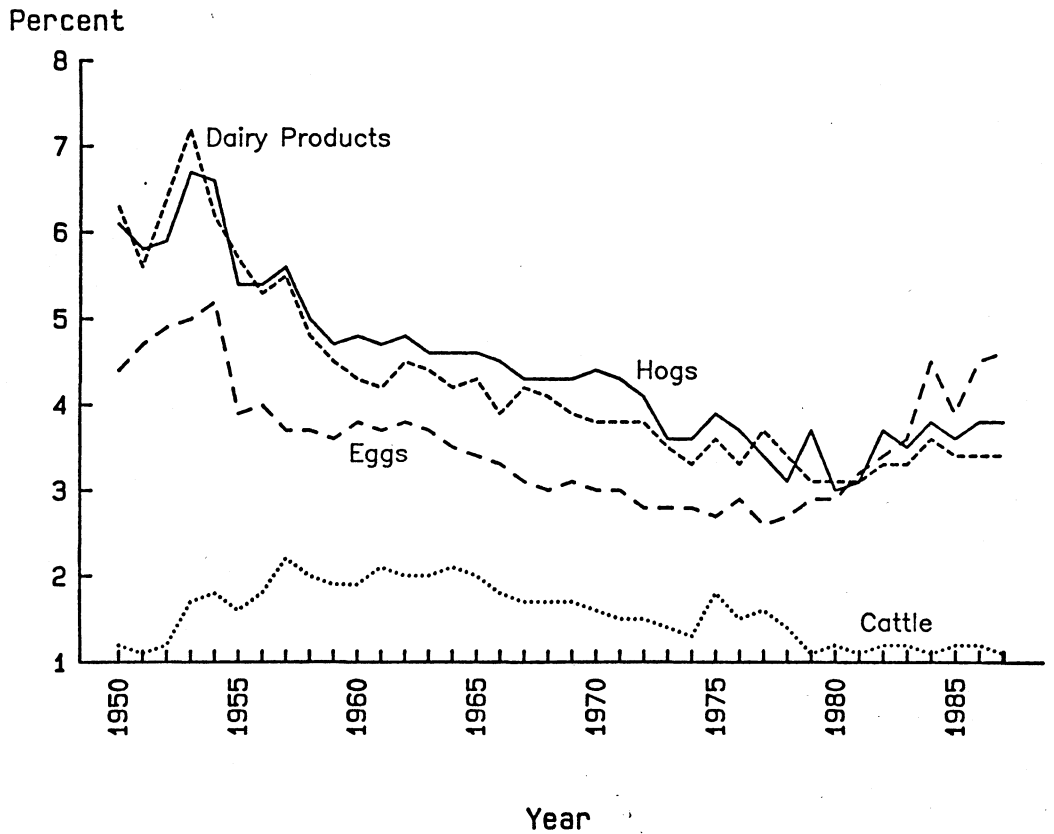

Figure 11. Ohio Livestock Receipts, Percent of U.S.

Explaining Changes in Farming Output

Various explanations could account for the decline in Ohio's share of U.S. farm output.

1. Declining yields in Ohio relative to the nation.

2. Fewer inputs used in Ohio as apparent in declining farm real production expenses, real assets, land, and labor.

3. Heavy reliance on small farms and part-time farming associated with industrialization. Competition with off-farm work time could cause farmers to shift from labor-intensive enterprises such as dairy and hog production to more labor-extensive crops such as grains and soybeans. These not altogether unrelated explanations are explored in the following pages.

Yield Trends

Yields of soybeans, corn, and wheat (the three major crops of Ohio) have increased sharply since 1950 (Figure 12). Gains are especially notable for corn. In determining competitive advantage, however, it is well to examine yield trends in Ohio relative to those in the nation.

From Figure 13 it is apparent that:

1. Soybean yields in Ohio vary widely relative to those in the nation as might be expected because yields for individual states average out in national numbers. Weather influences annual crop output more than livestock output.

2. Since 1973 soybean yields in Ohio have increased relative to those in the nation. This indicates that noncompetitive yields are not the source of changes in the composition and level of commodity output in Ohio -- at least in the case of soybeans.

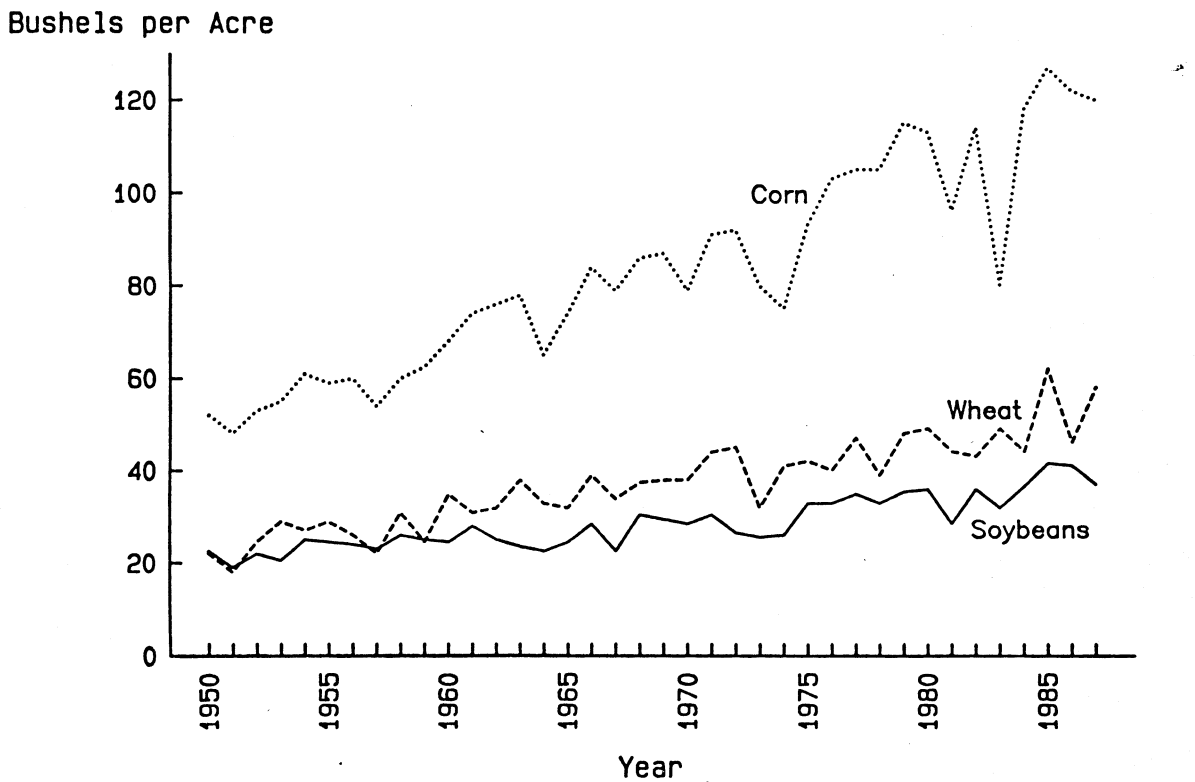

Figure 12. Ohio Crop Yields.

New varieties of soybeans have been released by the Ohio Agricultural Research and Development Center which will help to keep state soybean yields competitive.

Figure 13 gives a somewhat different trend for corn yields.

1. Corn yields in Ohio declined relative to those in the nation from 1955 to 1973.
2. Since 1973, corn yields in Ohio have tended to stabilize relative to those in the nation although trends are obscured by substantial variation around the mean.

As shown in Figure 13, wheat yields in Ohio as a percent of national yields display trends opposite to those of real wheat receipts shown in Figure 8 or actual yields shown in Figure 12.

1. Since the late 1950s, wheat yields in Ohio have increased relative to those in the nation.
2. Like soybeans and unlike corn, wheat yields in Ohio have averaged well above those in the nation.

The Ohio Agricultural Research and Development Center has played a critical role in making available high-yielding wheat varieties to producers.

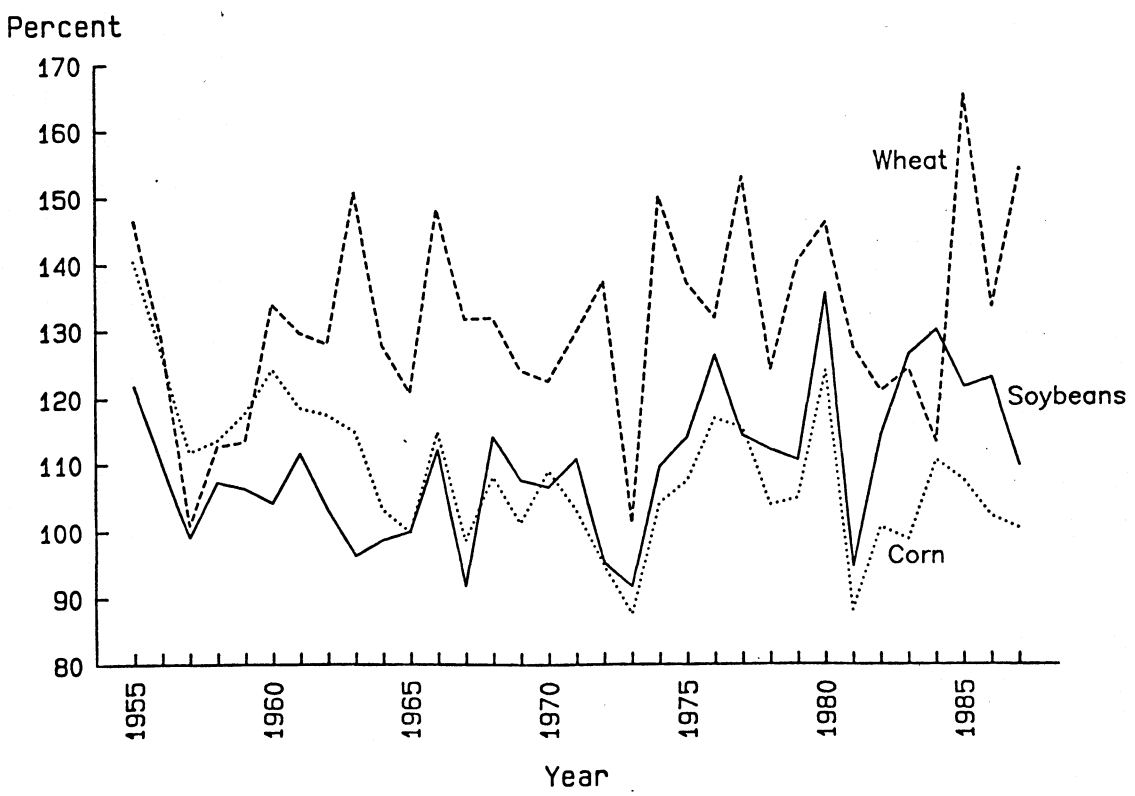

Figure 13. Ohio Crop Yields, 1955-1987 as Percent of U.S.

The Changing Input Structure of Farming

We noted earlier that production expenses in Ohio have increased in real terms since 1950. Relative to the rest of the nation, however, the trend has been quite different as apparent in Figure 14.

1. Production expenses in Ohio generally have declined over time relative to those in the U.S. The implication is that one of the reasons for a falling share of farm production in Ohio is because the state's farmers are using fewer inputs. That begs the question of why farmers are using fewer inputs.

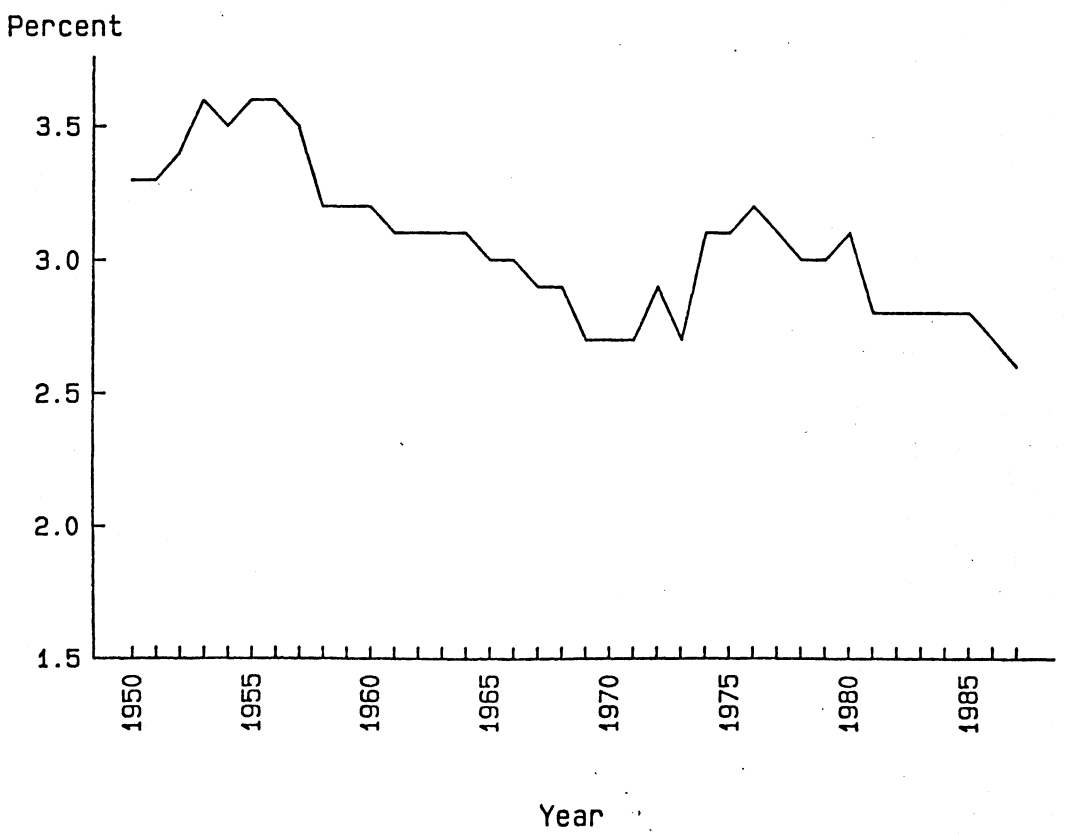

Figure 14. Ohio Farm Production Expenses, Percent of U.S.

2. With the exception of the middle to late 1970s, the downtrend in production inputs relative to the nation has been quite consistent since 1955.

Table 4 shows the composition of production expenses in Ohio and the U.S. for 1986. The major production expenses in the U.S. and Ohio are for feed, fertilizer and lime, interest, and depreciation of capital. Ohio ranks high relative to the U.S. in purchase of items for crop production including seed, fertilizer and lime, pesticides, fuel and oil, repairs, and capital consumption.

Table 4. Production Expenses, Ohio and U.S., 1986.

Item	U.S.		Ohio	
	Billion Dollars	Percent	Million Dollars	Percent
Farm Original Purchased Inputs				
Feed	16.2	13.3	345.6	10.4
Livestock and Poultry	9.6	7.9	67.5	2.0
Seed	3.0	2.5	131.6	4.0
Manufactured Inputs				
Fertilizer and Lime	5.8	4.8	262.5	7.9
Pesticides	4.3	3.5	141.5	4.3
Fuel and Oil	4.8	3.9	139.6	4.2
Electricity	2.1	1.7	52.5	1.6
Other				
Repairs and Maintenance	6.4	5.2	245.2	7.4
Interest	16.9	13.8	399.7	12.0
Contract and Hired Labor	9.9	8.1	181.6	5.5
Rent to Nonoperator Landlords	6.7	5.5	206.4	6.2
Capital Consumption (Depreciation)	19.0	15.6	694.3	20.9
Property Taxes	4.1	3.4	119.5	3.6
Miscellaneous	13.2	10.8	330.3	10.0
Total	122.0	100.0	3,317.8	100.0

Source: U.S. Department of Agriculture.

Balance Sheet Data

Farm production expenses give clues to changes in the structure of farm assets. The latter help to explain trends in commodity output in Ohio. Real estate and machinery and motor vehicles dominate farm assets. Real estate accounts for two-thirds of farm assets and machinery and motor vehicles for another one-seventh. These categories together account for 80 percent of assets.

Figure 15 shows that in constant 1987 dollars farm assets including the farm dwelling increased sharply in Ohio to 1983 and then declined as high real interest rates and lower farm income produced debt stress. An upturn in real asset values is apparent in 1987.

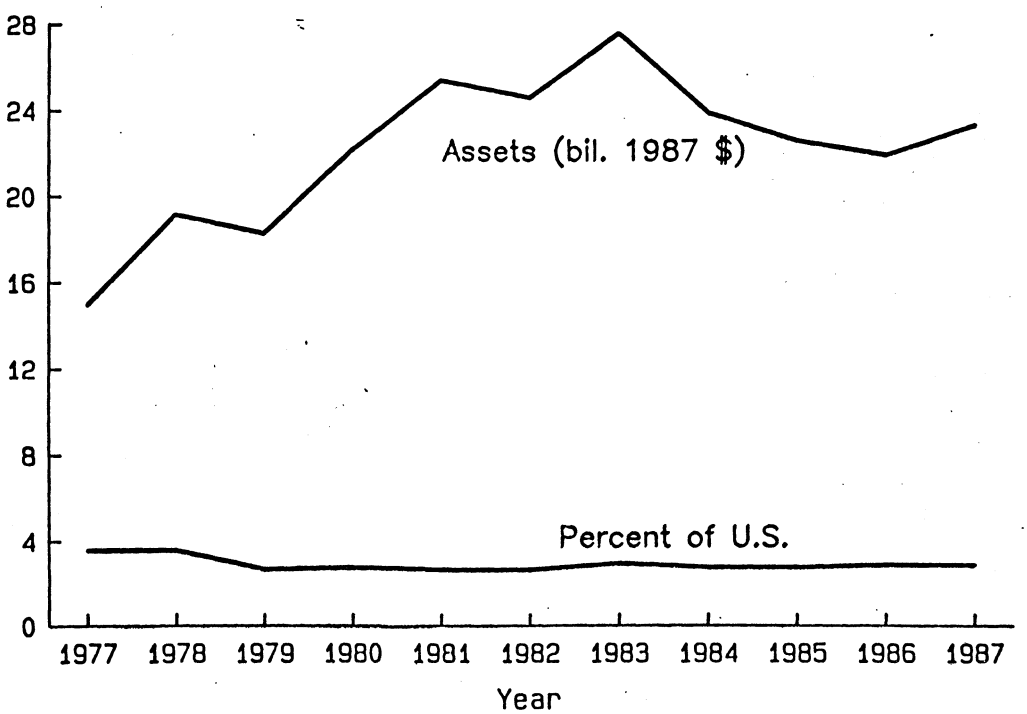

Figure 15. Ohio Real Assets, 1977-1987.

Debt in constant 1987 dollars as shown in Figure 16 increased even more rapidly than assets. Figures 15 and 16 show that the trend in assets and debt in Ohio closely follow that of the U.S. as measured by the state's farm assets and debt as a percent of U.S. values.

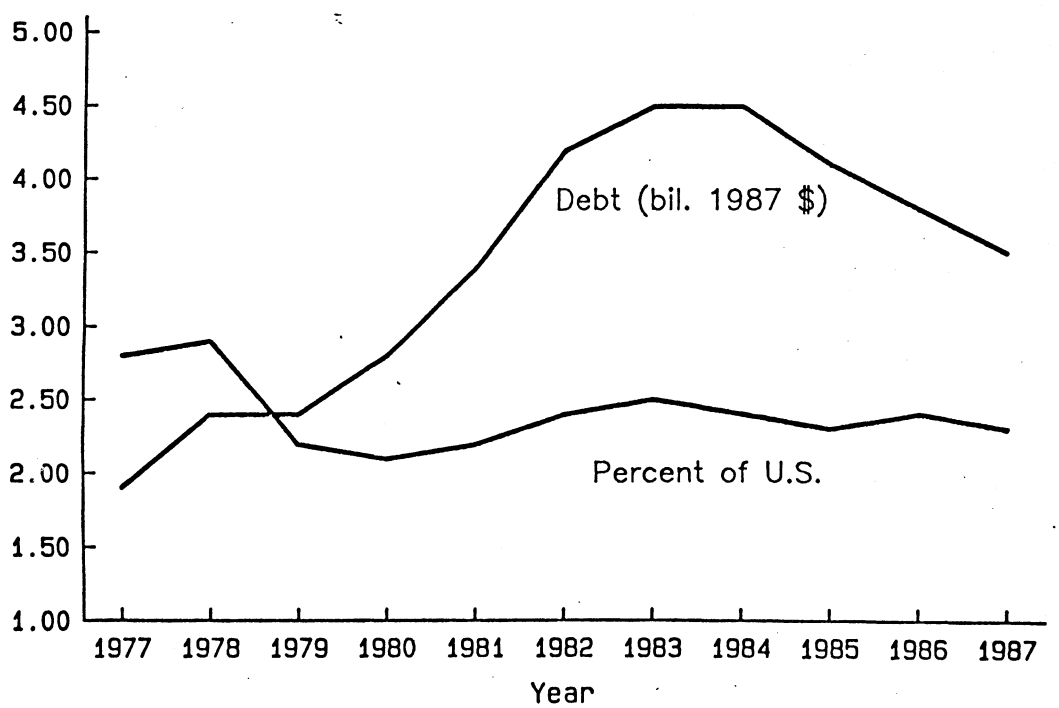

Figure 16. Ohio Real Debt, 1977-1987.

Ohio farm real equity for the 1977-87 period increased to 1983 and then declined as shown by Figure 17.

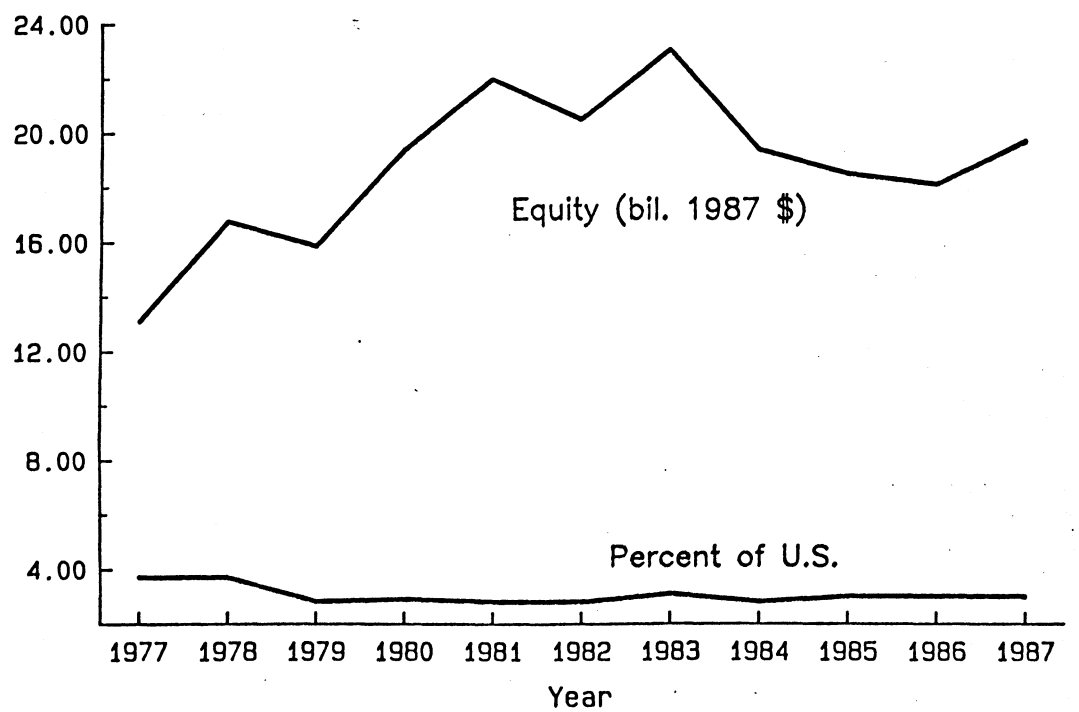

Figure 17. Ohio Real Equity, 1977-1987.

The ratio of debt to assets for Ohio and the U.S. more sharply distinguishes unique patterns.

1. The ratio of U.S. farm debt to assets has been higher than that for Ohio over time. Ohio investors have been more cautious. However, much of the lower debt-asset ratio in Ohio is explained by dominance of small farms (as noted later) which have low debt-asset ratios not only in Ohio but nationwide.
2. The debt-asset ratio increased in both the U.S. and Ohio from the late 1970s to 1984. Then the Ohio ratio of debt to assets dropped before the U.S. ratio, indicating that financial recovery began in Ohio earlier than in the U.S. as indicated in Figure 18.

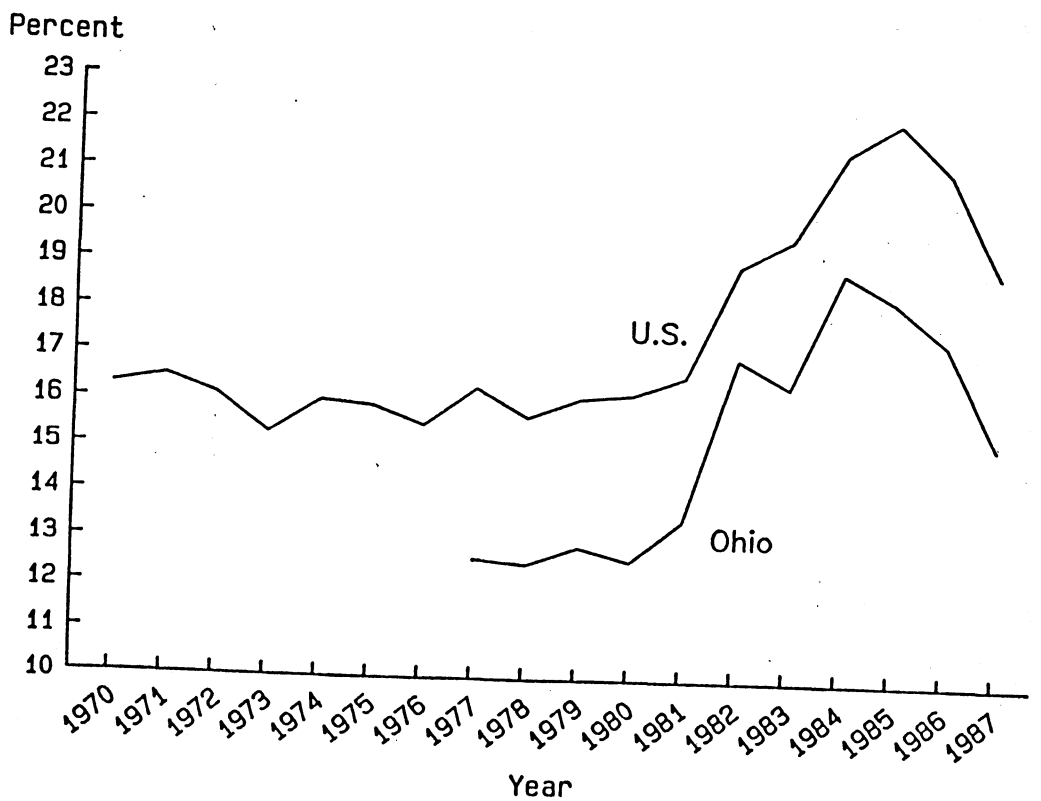

Figure 18. Ratio of Debt to Assets for Ohio and U.S.

Other Changes in Farm Input Structure

Farm size, numbers, and inputs such as land and labor help explain commodity, expense, and balance sheet trends noted earlier. Figure 19 displays changes in farm size and numbers.

1. The number of farms increased in Ohio to year 1890 and then began a gradual decline interrupted in the early 1930s by the Great Depression and continuing to the present. The downtrend in number of farms is slowing, however. Land in farms in Ohio has dropped from over 24 million acres to 15 million acres (Figure 20). Narrow farm profit margins encouraged some land to shift from cropland and from farming to other uses.

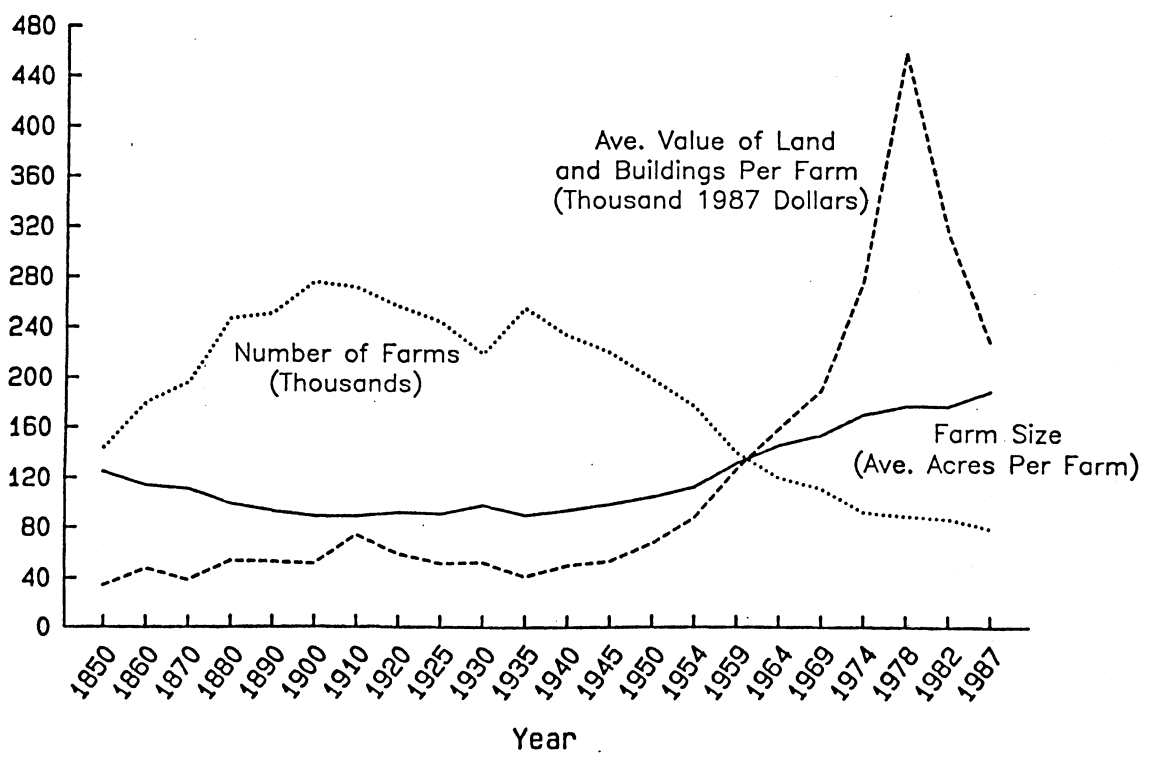

Figure 19. The Changing Structure of Ohio Farming by Census Years.

2. The increasing land values in the 1970s associated with low real interest rates, expectations of continued future gains in land earnings, and expanding export markets contributed to the rise in land values, a trend which then sharply reversed in 1981 as noted in Figure 19.

3. Farm population has dropped even more rapidly than land in farms, hence farm size has increased since 1940 as apparent from Figure 19. Trends in land in farms and farm population are shown more clearly in Figure 20. For the period from 1950 to 1987, land in farms dropped 28 percent in Ohio compared to a U.S. decline of only 16 percent. In contrast, population on farms in the U.S. fell 78 percent compared to 65 percent for Ohio.

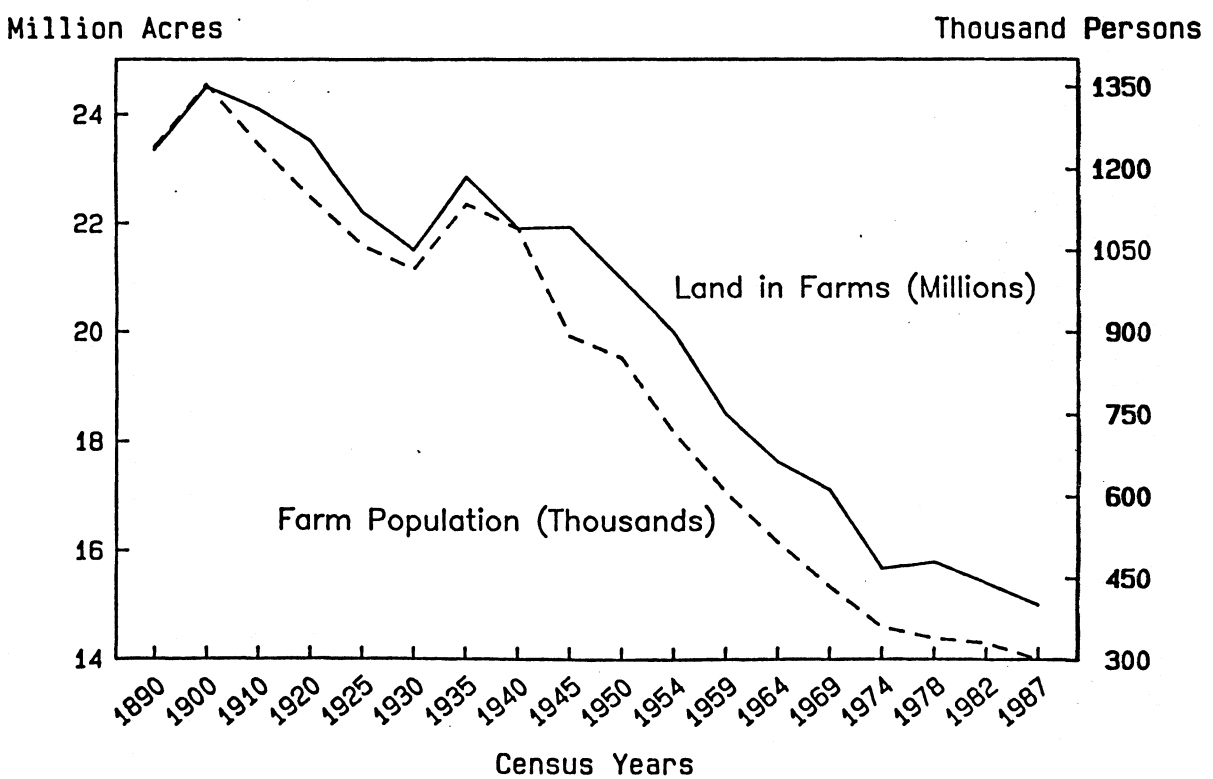

Figure 20. Land in Farms and Farm Population by Census Years.

4. The downturn in farmland acres in Ohio has occurred at a faster rate than in the U.S. because of major urban development in the state and shifts of some cropland and pasture to other uses. Urban employment growth contributed to the outmovement of farm people especially from full-time medium-size and small full-time farms. On the other hand, urban-industrial development created opportunities for part-time farming on small operations, holding down the rate of increase in farm size to a level below that in many less urbanized states.

5. The downtrend in cropland and land in farms fails to note changes within crops such as apparent in Figure 21. In general corn acreage has held its own or expanded since 1950. The sharp rise in soybean acreage contrasts with a decline in wheat acreage.

Changes in Farm Size

Ohio has a higher percentage of small farms than the U.S. as a whole. Trends in numbers of farms by size are provided in Figure 22. Trends are distinctively different between size categories.

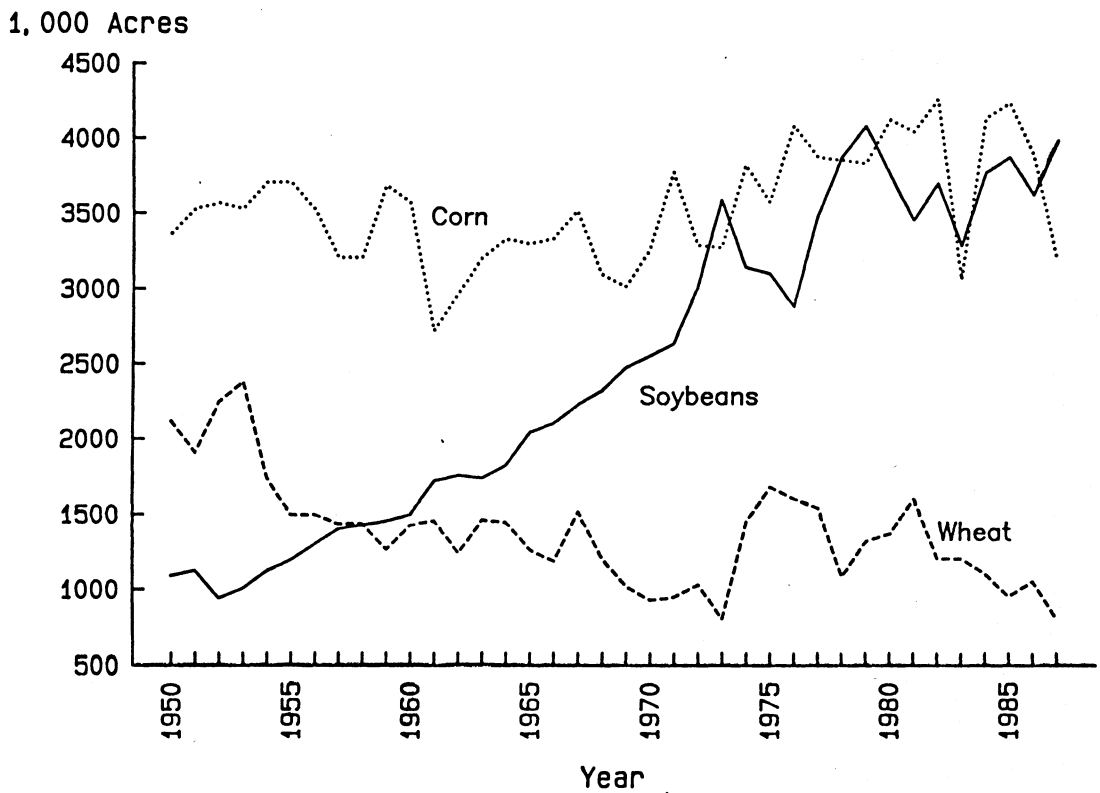

Figure 21. Ohio Crop Acreage, 1950-1987.

1. Mid-size farms, defined here as those with 50-500 acres, have consistently declined in numbers since 1959 but continue to outnumber other classes of farms measured by acres.

2. Small farms defined as those with 1-50 acres declined substantially in numbers from 1959 to 1974, then slightly increased or held steady in numbers in later years. The rapid decline in earlier years was the result of many full-time operators of small farms expanding farm size or exiting farming. Some full-time operators became part-time operators. These and part-time operators

from other backgrounds have staying power, and now dominate and stabilize small farm numbers. The substantial number of small farms could be reduced by a change in definition of a farm, currently defined as an operating unit with annual sales of crops and livestock normally of $1,000 or more.

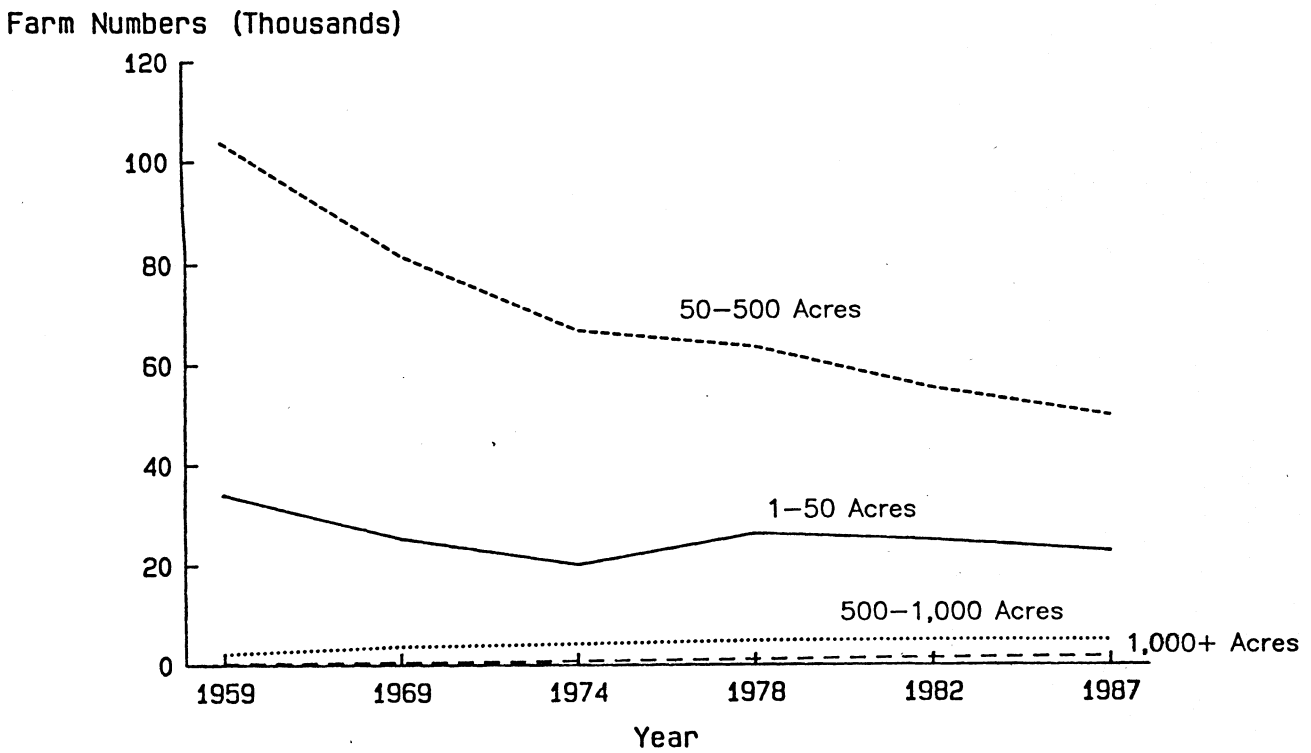

Figure 22. Farm Numbers by Farm Size for Selected Years, 1959-1987.

3. Large farms defined as those with over 500 acres gradually increased in numbers over the entire period since 1959. These are a minority of all farms but account for a sizable portion of output of crops and livestock.

Figure 23 showing farm numbers as a percent of 1959 numbers more dramatically illustrates these trends by size.

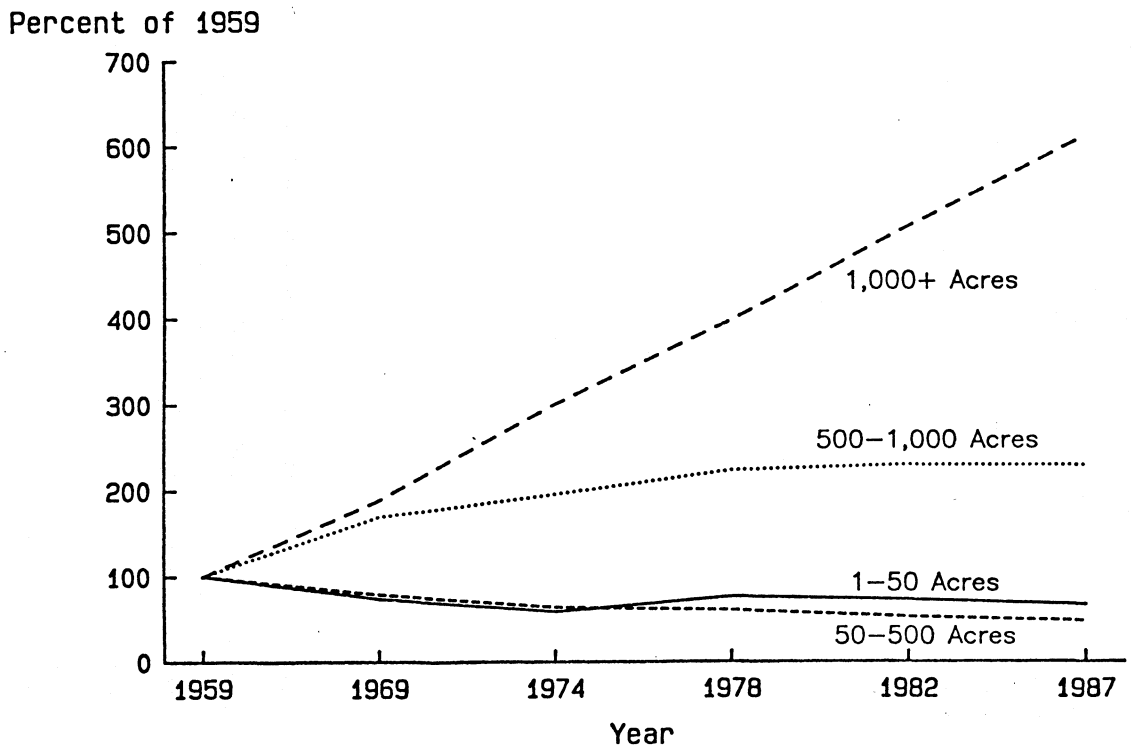

Figure 23. Farm Numbers as Percent of 1959 Numbers for Selected Years.

1. The number of large farms (1,000 plus acres) increased more than six-fold since 1959.
2. The number of upper mid-size farms (500-1,000 acres) increased slightly in numbers.
3. Lower mid-size farms as measured by those with 50-500 acres declined as a percent of 1959. The same is true of small farms with 1-50 acres but small

farm numbers now appear to be holding their own as indicated earlier in Figure 23.

Part-time Farming

Opportunities for off-farm employment in Ohio generated substantial part-time farming especially by operators on small farms. Patterns of part-time operation are noted in Figure 24.

1. In all years the percentage of part-time farmers (200 plus days off-farm work per year) was higher in Ohio than in the U.S.
2. The percentage of part-time farmers has remained somewhat stable since 1969 at approximately 40 percent. (The share of part-time farmers would be 57 percent in 1987 if operators who worked *any* days off the farm are called "part-time".)

Patterns of part-time farming across the state are apparent in Figure 25. One would expect incidence of part-time farming to be high in parts of the state characterized by heavy urbanization, by marginal quality land placing demands on operators to supplement farm income, and in parts of the state where terrain is less suited for mechanization and other technological advances.

1. Perhaps the most notable single conclusion in examining Figure 25 is that part-time farming is widespread among counties in Ohio.

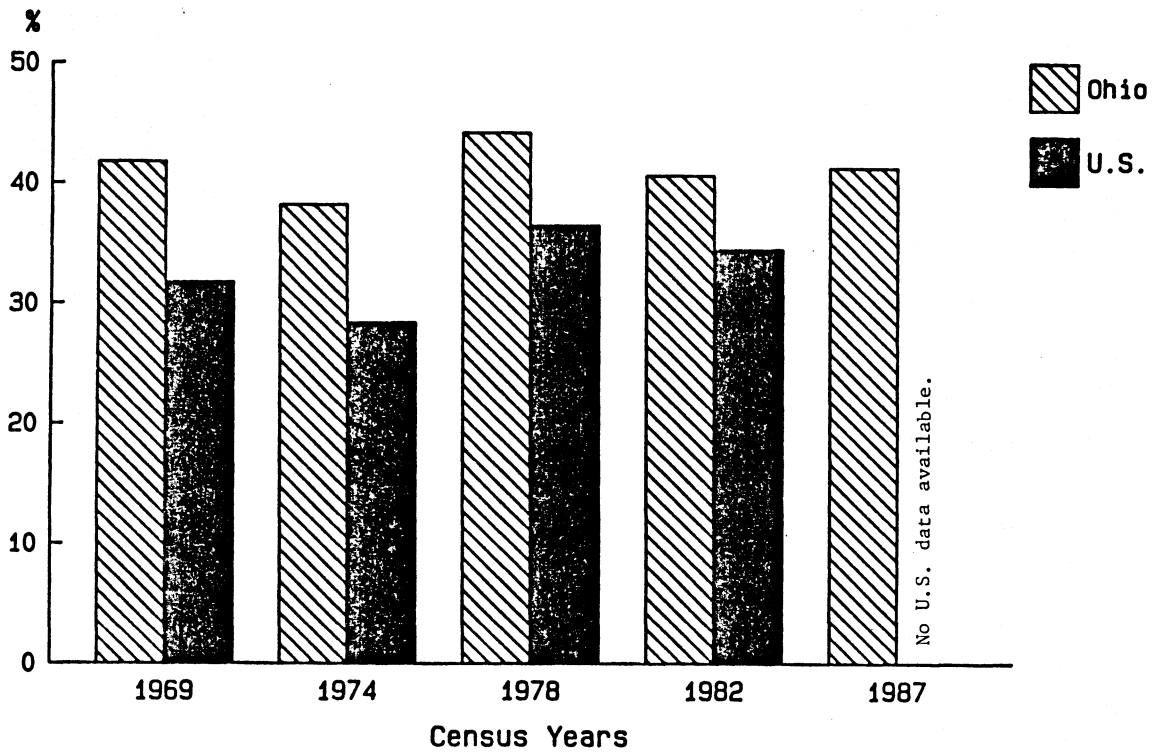

Figure 24. Percent of Part-time Operators.

2. The hypothesis that part-time farming is most prevalent in areas of the state with soils and terrain least suited for commercial farming is evident from the high incidence of part-time farming in southeast Ohio.

3. High incidence of part-time farming is also found in counties near the Cleveland-Akron-Youngstown, Cincinnati-Dayton, and Toledo metropolitan areas.

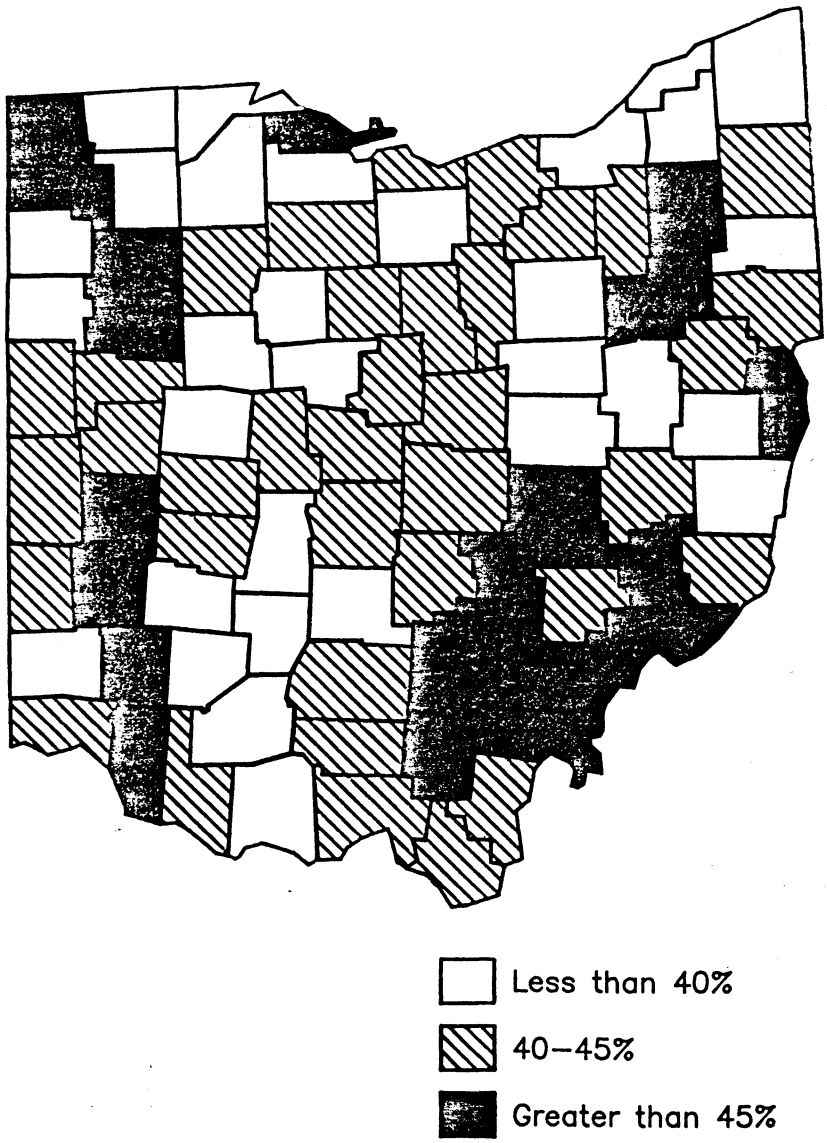

Figure 25. Percent of Part-time Farms, 1987.

The percentage change in numbers of part-time farms between 1982 and 1987 provides further clues to the role of part-time farming in agriculture (Figure 26).

1. Most notable declines in part-time farming occurred in the southern and eastern areas of the state less characterized by commercial farming than the northwest.

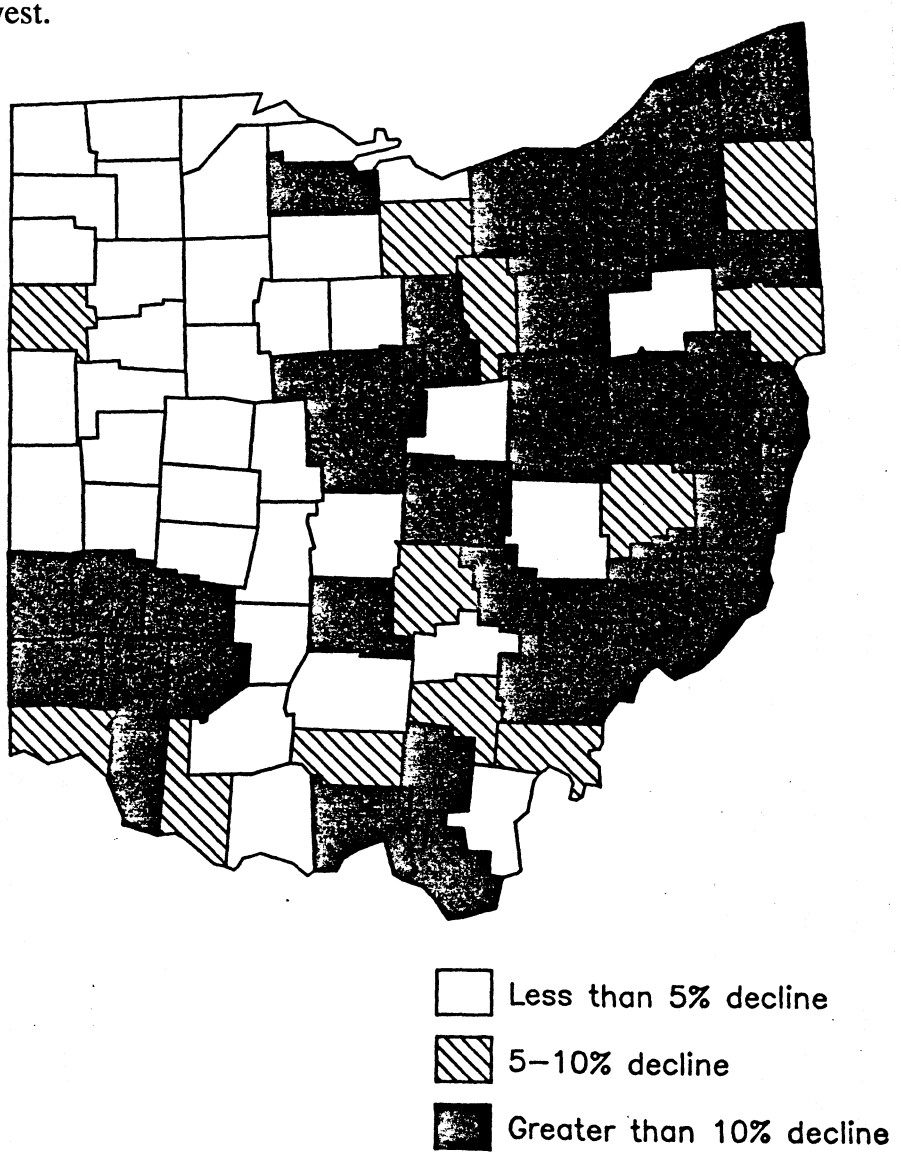

Figure 26. Percent Change in Number of Part-time Farms, 1982 and 1987.

2. Comparing Figure 26 with Figure 25, it is apparent that some of the decline in part-time farming between 1982 and 1987 came in areas where part-time

farming has been prominent. Many part-time farm operators, like commercial farm operators, found the economic rewards unattractive in the 1980s. Some such part-time operators exited their farming operations to minimize losses. Loss of industrial jobs in the eastern part of Ohio may also have removed some of the off-farm economic base supporting part-time farming.

The percentage changes in numbers of *all* farms between 1982 and 1987 by county shown in Figure 27 were substantial near urban areas. The Cleveland-Columbus-Dayton-Cincinnati corridor displayed a particularly rapid decline in numbers of farms. Counties along the Ohio River also experienced substantial losses in farms in part because of a decline in tobacco production. A number of commercial farming counties relatively dependent on farm income in west central and northwest Ohio experienced lower percentage changes in farm numbers.

Income Enhancement through Research and Extension

Farmers hardly need to be reminded that they are in a highly competitive industry. Ohio's farmers have improved their technology, management, marketing, and farming structure to keep abreast of the competition. Many farmers might wish to stop or slow the technology treadmill to make life easier but that is not feasible if they wish to remain competitive with other domestic and foreign producers. Labor-saving technology has replaced many workers from farms but has also reduced the drudgery of some farm jobs. On the whole, productivity has advanced at a more rapid rate than real farm prices have declined so that producers receive a higher real output price per unit of real resources

today than in 1910-14.

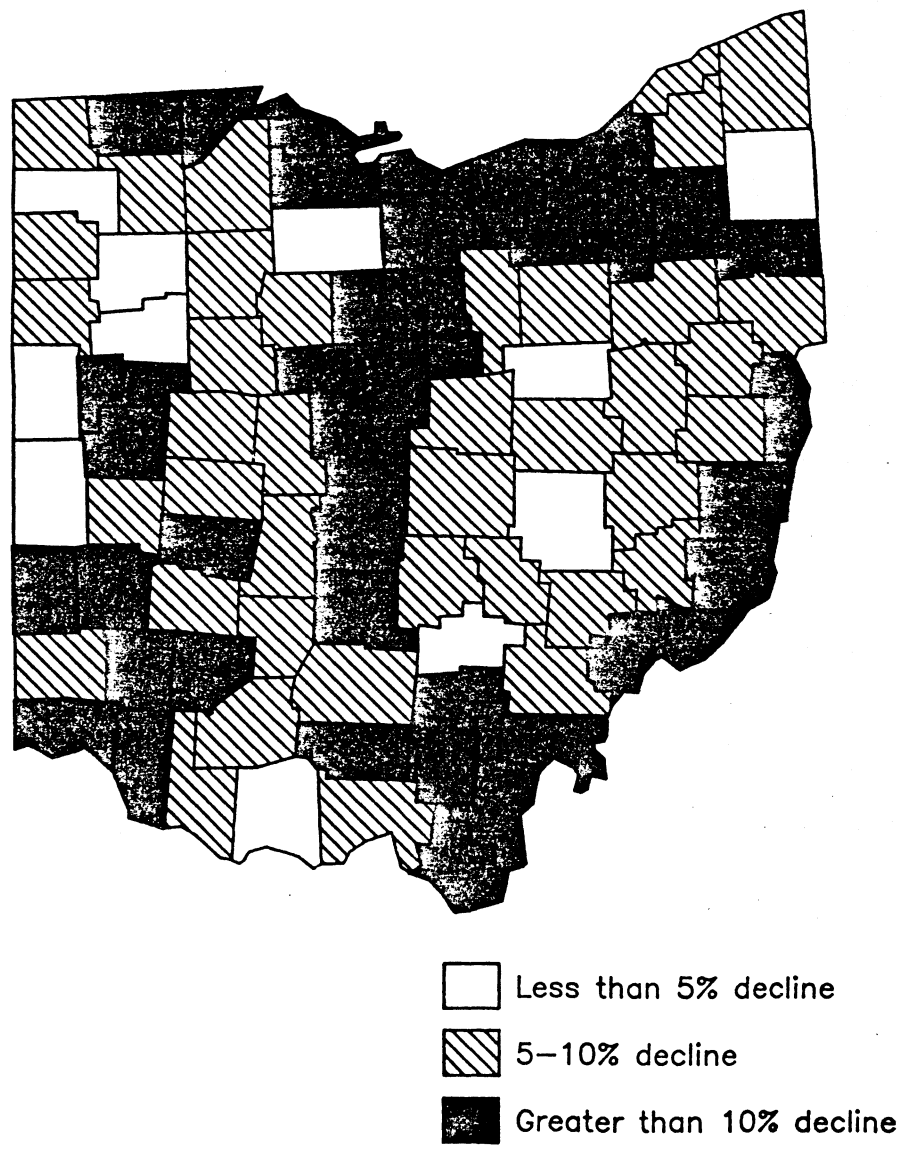

Figure 27. Percent Change in Farm Numbers, 1982 and 1987.

Economic Payoff

Productivity advances came from a joint effort of farmers, agribusiness industries, universities, and others. That effort has been spectacularly successful -- estimates by economists at the University of Chicago, Yale University, and elsewhere place the rate of return on U.S. agricultural production research and extension at 50 percent on investment (see Ruttan; Braha and Tweeten). This means that up to a 50 percent interest rate could have been paid on funds for research and extension to break even on that investment. A recent estimate by Huffman and Evenson shows a rate of return of 64 percent for public crop research, 43 percent for public extension, and 77 percent for farmers' schooling. Another recent estimate for the 1944-1983 period by Fox, Evenson, and Ruttan shows an even higher rate of return, 180 percent, both on commodity specific crop research and disciplinary biological crop research. Bredahl and Peterson in the *American Journal of Agricultural Economics* reported analysis out of Minnesota showing that each $1 invested by Ohio on public research in dairy production returned $5.32, in cash grain production returned $4.17, in poultry returned $3.13, and in livestock returned $5.28. It would be difficult indeed to find major alternative public or private investments offering higher payoffs.

The Historic Record

The final three graphs reveal trends in real outlays for agricultural research and extension from 1970 to 1987 (see Annex Tables 1 and 2 for actual data).[1] For comparison,

[1]Research and extension inputs were adjusted to real outlays by deflating by the gross national product deflator for government services.

data are included for the 5-state surrounding region (Indiana, Michigan, Pennsylvania, Kentucky, and West Virginia) as well as Ohio.

Findings for agricultural research shown in Figure 28 are that:

1. Real agricultural research outlays from federal sources alone increased slightly from 1970 to the late 1970s in Ohio, then fell to near 1970 levels. Real outlays for the five-state surrounding region remained nearly flat, averaging approximately $7.5 million per year per state.

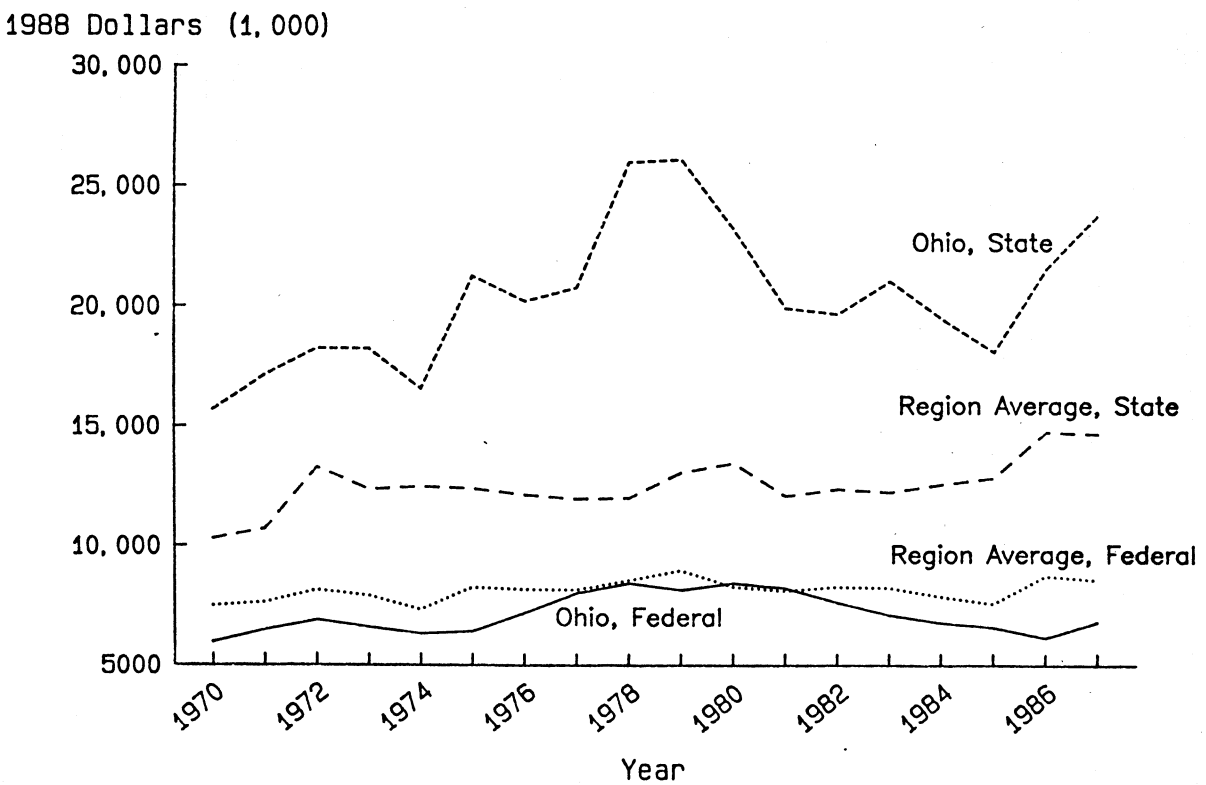

Figure 28. Real Agricultural Research Outlays (1988 Dollars).

2. Real outlays from state sources for agricultural research rose in the 1970s, then fell sharply. Despite sizable gains since 1985, real outlays were lower

in 1987 than in the late 1970s.

3. In part because agriculture is larger in Ohio than in the average surrounding state, state outlays are higher for Ohio than for other states on average. Differences need to be adjusted for the size of the farming industry in each state. This will be done after examining agricultural extension outlays.

Findings for agricultural extension outlays shown in Figure 29 include:

1. Federal outlays (real) for extension have fallen sharply both for Ohio and the five-state surrounding region.

2. State outlays alone for extension fared better in Ohio than federal outlays or state outlays in other states. Federal outlays, once far exceeding state outlays for extension, recently have fallen below state outlays both for Ohio and the region.

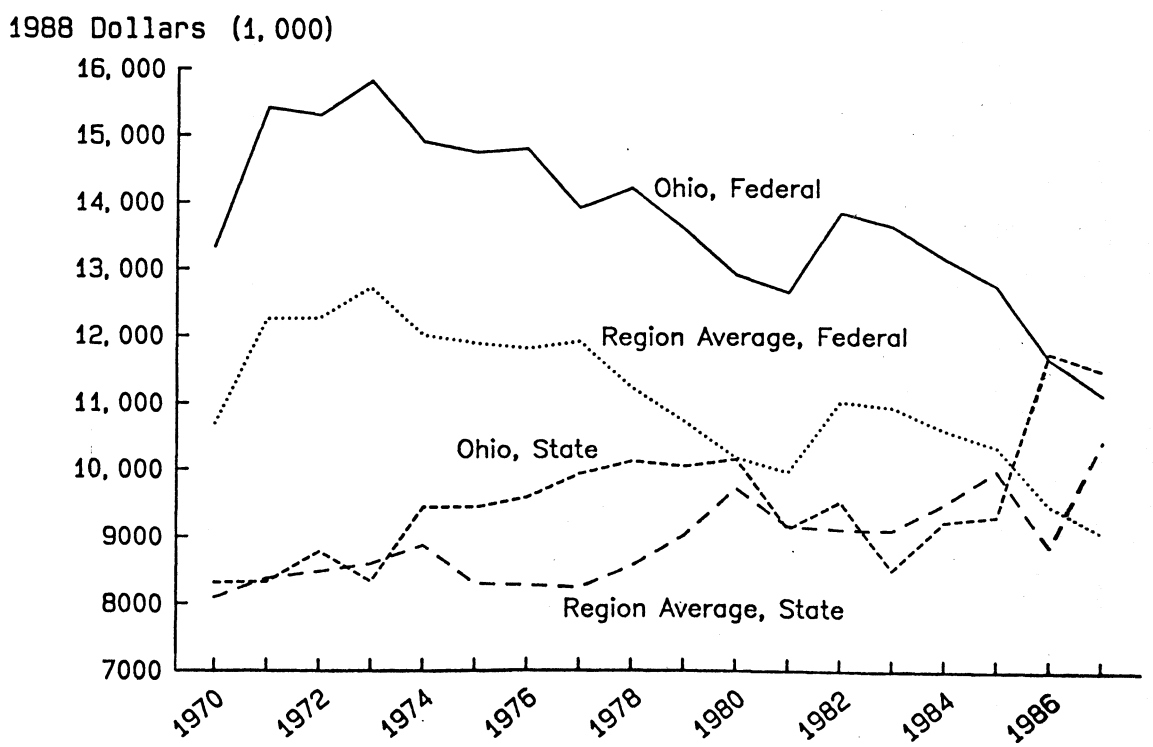

Figure 29. Real Agricultural Extension Outlays (1988 Dollars).

Figures 28 and 29 provided useful insights into long-term trends but were not suitable for absolute comparisons between states because funding is expected to be related to the size of agriculture which, of course, differs among states. Figure 30 attempts to adjust for that factor by comparing total real agricultural research and extension outlays per $1,000 of gross farm income.

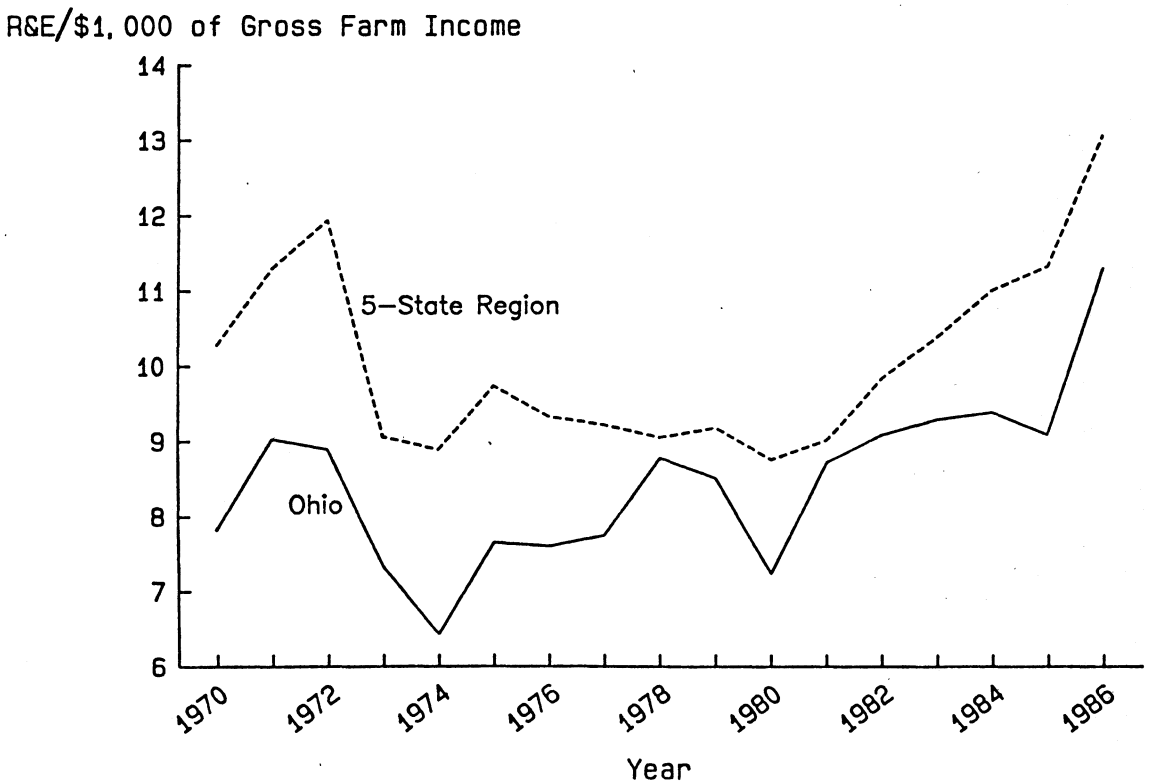

Figure 30. Real Agricultural Research and Extension (R&E) Outlays from State and Federal Sources per $1,000 Gross Farm Income (1988 Dollars).

1. Ohio has lagged behind surrounding states in research and extension funding from state and federal sources per $1,000 of gross farm income. Funding for agricultural research and extension from state sources alone per $1,000 of gross farm income lagged that of the average for surrounding states for the

1970-1986 period except for brief periods in the late 1970s and early 1980s.

2. Based on studies indicating a high payoff from investment in agricultural research and extension, the region in general and Ohio in particular are foregoing low cost sources of economic growth by underinvesting in public means to enhance income and productivity of agriculture.

Conclusions

Agriculture in Ohio is shaped by many forces including location, technology, urban-industrialization, and inertia of the past.

1. A most notable but often overlooked feature of Ohio agriculture is its representativeness of the nation. But the state is also unique in many respects. Compared to the U.S., Ohio has smaller average acreage per farm (177 versus 416 acres for the U.S. in 1982) and sales ($39,000 for Ohio versus $59,000 for the U.S. per farm in 1982). Ohio has a disproportionately high number of farms of 50-139 acres (33 percent for Ohio versus 24 percent for the U.S.) and a low number of farms of over 500 acres (7.5 percent for Ohio versus 16.3 percent for the U.S.) in 1982.

2. Ohio has a higher proportion of crops in general and of corn, soybeans, greenhouse and nursery, and wheat in particular than the U.S. Among livestock and livestock products, Ohio has higher proportions of dairy products and hogs than the U.S.

3. A dominant feature shaping Ohio's agriculture is urban-industrialization. That influence gives rise to numerous part-time, small farms. These farms in turn use labor-extensive commodity production, emphasizing grains and soybeans, while avoiding labor-intensive livestock production.

4. Livestock and crop production will expand in different ways in the future than in the past. Egg and broiler production, for example, is likely to expand on industrial-type large farming operations rather than on small family-type farms. This raises environmental and social issues. Environment issues arise over how to safely dispose of waste; social issues arise over displacement of family farms by very large farms. To rule out large corporate farming investments as some states have done also rules out opportunities for income and employment. The state will need to confront these issues and search for appropriate compromise.

5. Urban development encroaches on Ohio's farmland base. Thus increased crop production will come from higher yields rather than from additional cropland acreage. That implies that expansion of overall farm output and net income will require improved technology, management, nonland capital investments, intensification, and improved marketing.

6. Ohio's location provides excellent access not only to a large within-state urban industrial market but also to export markets utilizing (a) unit trains to northeast coast ports such as Philadelphia and Baltimore, (b) the Ohio-Mississippi River system leading to Gulf ports, and (c) Great Lakes-St. Lawrence Seaway outlets. These commerce outlets place Ohio in a unique

position to reach European, South American, and African markets. However, agricultural export markets are shifting toward the Pacific Rim. The appropriate strategy for Ohio remains to be worked out. Some farm commodities moving from the western cornbelt to eastern markets will in the future move to Pacific markets. This will leave more Ohio production to fill eastern markets and perhaps less to be exported. The result could be more processing of farm commodities for domestic and foreign consumption in part to reduced transport costs per unit value.

7. The Ohio food processing industry is well developed and a potential future source of substantial growth in the state's food and fiber system serving domestic and foreign markets. The state has approximately 1,000 processing firms, many of them small, but in a position to innovate. They not only can raise income of the food industry but also can raise farm income by providing additional outlets for crops and livestock.

8. Because pressures of time associated with off-farm employment have limited adoption of technology on small farms and because of insufficient resources for agricultural research and extension education, opportunities are substantial to improve technology in the state's agriculture. For example, the Governor's Commission on Agriculture (p. 41) reported that application of unused technology in the area of crop production techniques could increase the state average yield of corn, soybeans, and wheat by 18, 16, and 32 percent respectively.

9. Ohio lags surrounding states on average in public research and extension per farm and per dollar of farm output. Given the very high payoff from such investments, the state is foregoing opportunities for low-cost sources of future income and employment. Overcoming that gap would appear to be a high-priority not only to remain competitive in agriculture but to promote economic development in Ohio.

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Annex Table 1. Actual Federal and State Funding for Agricultural Research for Ohio and Surrounding States, 1970-1987.

Year	Ohio		Indiana		Michigan		Pennsylvania		Kentucky		West Virginia		5-State Average*	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
							($1,000)							
1970	1,812.00	4,751.00	3,291.00	4,492.00	3,060.00	4,177.00	2,431.00	3,882.00	1,527.00	2,223.00	1,063.00	815.00	2,274.40	3,117.80
1971	2,102.00	5,534.00	3,204.00	4,684.00	3,587.00	5,028.00	2,678.00	4,347.00	1,716.00	2,292.00	1,182.00	952.00	2,473.40	3,460.60
1972	2,363.00	6,232.00	4,014.00	5,627.00	3,665.00	5,978.00	3,115.00	4,125.00	1,875.00	5,868.00	1,281.00	1,102.00	2,790.00	4,540.00
1973	2,381.00	6,569.00	4,394.00	5,959.00	3,261.00	6,234.00	3,294.00	4,345.00	1,984.00	4,545.00	1,357.00	1,206.00	2,858.00	4,457.80
1974	2,458.00	6,424.00	4,165.00	6,392.00	3,376.00	7,149.00	3,209.00	4,714.00	2,066.00	4,758.00	1,443.00	1,222.00	2,851.80	4,847.00
1975	2,721.00	8,975.00	4,834.00	6,779.00	5,198.00	7,607.00	3,621.00	5,337.00	2,289.00	5,161.00	1,552.00	1,315.00	3,498.80	5,239.80
1976	3,276.00	9,178.00	5,551.00	7,822.00	4,909.00	7,715.00	3,912.00	5,898.00	2,543.00	4,830.00	1,696.00	1,322.00	3,722.20	5,517.40
1977	3,940.00	10,183.00	5,876.00	8,357.00	5,255.00	9,159.00	4,100.00	5,288.00	2,971.00	5,071.00	1,851.00	1,477.00	4,010.60	5,870.40
1978	4,450.00	13,662.00	6,678.00	8,674.00	5,709.00	10,072.00	4,782.00	5,697.00	3,319.00	5,567.00	2,076.00	1,620.00	4,512.80	6,326.00
1979	4,641.00	14,817.00	7,832.00	11,458.00	6,452.00	11,719.00	5,786.00	5,660.00	3,361.00	6,482.00	2,109.00	1,852.00	5,108.00	7,434.20
1980	5,302.00	14,533.00	7,602.00	13,318.00	6,965.00	12,798.00	5,631.00	6,442.00	3,637.00	7,702.00	2,174.00	1,938.00	5,201.80	8,439.60
1981	5,701.00	13,757.00	8,475.00	15,487.00	6,835.00	9,127.00	6,391.00	6,756.00	4,047.00	8,382.00	2,356.00	2,037.00	5,620.80	8,357.80
1982	5,733.00	14,725.00	8,782.00	15,645.00	8,916.00	12,439.00	6,570.00	7,324.00	4,306.00	8,769.00	2,536.00	2,219.00	6,222.00	9,279.20
1983	5,656.00	16,671.00	10,066.00	16,592.00	8,414.00	12,554.00	6,935.00	7,900.00	4,766.00	9,207.00	2,572.00	2,316.00	6,550.60	9,713.80
1984	5,693.00	16,285.00	9,974.00	17,130.00	8,600.00	14,737.00	7,133.00	8,369.00	4,628.00	9,802.00	2,687.00	2,576.00	6,604.40	10,522.80
1985	5,821.00	15,902.00	10,301.00	17,558.00	8,256.00	16,576.00	7,279.00	8,986.00	4,729.00	10,945.00	2,845.00	2,405.00	6,682.00	11,294.00
1986	5,630.00	19,668.00	11,948.00	20,430.00	12,190.00	19,848.00	8,735.00	11,083.00	4,325.00	13,318.00	2,717.00	2,610.00	7,983.00	13,457.80
1987	6,527.00	22,717.00	11,398.00	20,443.00	12,798.00	20,174.00	9,576.00	13,272.00	4,329.00	13,390.00	2,803.00	2,704.00	8,180.80	13,996.60

Source: Inventory of Agricultural Research, Table IV-E, 1970 and earlier years.

*Excludes Ohio.

Annex Table 2. Actual Federal and State Funding for Agricultural Extension for Ohio and Surrounding States, 1970-1987.

Year	Ohio		Indiana		Michigan		Pennsylvania		Kentucky		West Virginia		5-State Average*	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
	($1,000 Dollars)													
1970	4,036.00	2,515.00	2,860.00	2,317.00	3,389.00	4,049.00	4,286.00	2,203.00	3,728.00	2,763.00	1,922.00	913.00	3,237.00	2,449.00
1971	4,977.00	2,686.00	3,430.00	2,498.00	4,159.00	4,552.00	5,395.00	2,556.00	4,461.00	2,943.00	2,343.00	971.00	3,957.60	2,704.00
1972	5,227.00	3,000.00	3,635.00	2,603.00	4,353.00	4,891.00	5,640.00	2,752.00	4,900.00	3,206.00	2,426.00	1,030.00	4,190.80	2,896.40
1973	5,701.00	3,000.00	4,055.00	2,650.00	4,764.00	5,360.00	6,089.00	2,924.00	5,428.00	3,513.00	2,596.00	1,040.00	4,586.40	3,097.40
1974	5,785.00	3,665.00	4,159.00	2,657.00	4,849.00	5,697.00	6,177.00	3,331.00	5,492.00	3,771.00	2,630.00	1,751.00	4,661.40	3,441.40
1975	6,232.00	3,990.00	4,589.00	2,834.00	5,225.00	6,401.00	6,608.00	3,251.00	5,894.00	3,888.00	2,810.00	1,144.00	5,025.20	3,503.60
1976	6,734.00	4,361.00	4,874.00	3,562.00	5,537.00	6,597.00	7,098.00	3,296.00	6,361.00	4,049.00	2,999.00	1,291.00	5,373.80	3,759.00
1977	6,834.00	4,875.00	6,569.00	3,845.00	5,781.00	7,035.00	7,363.00	3,541.00	6,513.00	4,226.00	3,025.00	1,539.00	5,850.20	4,037.20
1978	7,492.00	5,333.00	5,424.00	4,396.00	6,202.00	8,227.00	7,819.00	3,710.00	6,950.00	4,592.00	3,193.00	1,592.00	5,917.60	4,503.40
1979	7,740.00	5,713.00	5,624.00	4,551.00	6,391.00	9,220.00	8,043.00	3,910.00	7,188.00	6,268.00	3,275.00	1,671.00	6,104.20	5,124.00
1980	8,105.00	6,366.00	5,939.00	5,069.00	6,689.00	11,180.00	8,379.00	4,850.00	7,497.00	7,460.00	3,397.00	1,906.00	6,380.20	6,093.00
1981	8,755.00	6,299.00	6,470.00	5,554.00	7,224.00	10,733.00	9,005.00	5,100.00	8,064.00	8,308.00	3,641.00	1,927.00	6,880.80	6,324.40
1982	10,380.00	7,128.00	7,917.00	6,183.00	8,796.00	10,762.00	10,541.00	5,500.00	9,711.00	9,501.00	4,284.00	2,143.00	8,249.80	6,817.80
1983	10,827.00	6,736.00	8,289.00	6,135.00	9,173.00	12,039.00	10,985.00	6,000.00	10,426.00	9,801.00	4,481.00	2,085.00	8,670.80	7,212.00
1984	11,015.00	7,715.00	8,488.00	8,177.00	9,364.00	12,574.00	11,194.00	6,150.00	10,709.00	10,794.00	4,528.00	2,007.00	8,856.60	7,940.40
1985	11,223.00	8,189.00	8,839.00	8,512.00	9,605.00	14,081.00	11,445.00	8,050.00	10,955.00	10,965.00	4,634.00	2,306.00	9,095.60	8,782.80
1986	10,652.00	10,727.00	8,367.00	3,842.00	9,131.00	15,551.00	10,890.00	6,600.00	10,430.00	11,810.00	4,441.00	2,612.00	8,651.80	8,083.00
1987	10,633.00	10,974.00	8,355.00	9,298.00	9,149.00	16,697.00	10,871.00	7,300.00	10,454.00	13,899.00	4,434.00	2,643.00	8,652.60	9,967.40

Source: ???, Table III, 1970 and earlier years.

*Excludes Ohio.